TRANSACTIONS

OF

The Association of Life Insurance Medical Directors of America

FIFTY-NINTH ANNUAL MEETING

James R. Gudger, M. D.
Editor

VOL. XXXIV

PRESS OF
Recording & Statistical Corporation
New York City
1951

CONTENTS OF VOLUME XXXIV

OFFICERS OF THE ASSOCIATION, 1949-1950

Harry E. Ungerleider, M. D. ..... *President*
Lauritz S. Ylvisaker, M. D. ..... *First Vice-President*
Linford H. Lee, M. D. ..... *Second Vice-President*
Henry B. Kirkland, M. D. ..... *Secretary*
Walter A. Reiter, M. D. ..... *Treasurer*
James R. Gudger, M. D. ..... *Editor of Proceedings*

EXECUTIVE COUNCIL

H. E. Ungerleider, M. D.
L. S. Ylvisaker, M. D.
Linford H. Lee, M. D.
H. B. Kirkland, M. D.
W. A. Reiter, M. D.
J. R. Gudger, M. D.
K. W. Anderson, M. D.
E. W. Beckwith, M. D.
C. C. Birchard, M. D.
J. G. Irving, M. D.
H. C. McAlister, M. D.
E. S. Williams, M. D.
R. L. Rowley, M. D.
H. M. Frost, M. D.
D. E. W. Wenstrand, M. D.
William Bolt, M. D.
S. J. Streight, M. D.
A. O. Jimenis, M. D.
A. J. Robinson, M. D.
E. G. Dewis, M. D.

OFFICERS OF THE ASSOCIATION SINCE ITS ORGANIZATION

Presidents

John M. Keating, M. D.	1889-1891
Frank Wells, M. D.	1891-1894
Edgar Holden, M. D.	1894-1897
H. Cabell Tabb, M. D.	1897-1899
George R. Shepherd, M. D.	1899-1902
Edward H. Hamill, M. D.	1902-1904
John W. Fisher, M. D.	1904-1906
Oscar H. Rogers, M. D.	1906-1908
Thomas H. Willard, M. D.	1908-1910
George Wilkins, M. D.	1910-1911
Brandreth Symonds, M. D.	1911-1912
Harry Toulmin, M. D.	1912-1913
Edward K. Root, M. D.	1913-1914
William E. Porter, M. D.	1914-1915
Franklin C. Wells, M. D.	1915-1916
Homer Gage, M. D.	1916-1917
Walter A. Jaquith, M. D.	1917-1918
Thomas H. Rockwell, M. D.	1918-1919
Faneuil S. Weisse, M. D.	1919-1920
Augustus S. Knight, M. D.	1920-1921
Thomas F. McMahon, M. D.	1921-1922
Frank L. Grosvenor, M. D.	1922-1923
William R. Ward, M. D.	1923-1924
Chester F. S. Whitney, M. D.	1924-1925
Angier B. Hobbs, M. D.	1925-1926
Wesley W. Beckett, M. D.	1926-1927
Robert M. Daley, M. D.	1927-1928
J. Allen Patton, M. D.	1928-1929
William Muhlberg, M. D.	1929-1930
Robert L. Rowley, M. D.	1930-1931
Charles L. Christiernin, M. D.	1931-1932
H. Crawford Scadding, M. D.	1932-1933
Robert A. Fraser, M. D.	1933-1934
Fred L. Wells, M. D.	1934-1935
Eugene F. Russell, M. D.	1935-1936
Chester T. Brown, M. D.	1936-1937
Samuel B. Scholz, M. D.	1937-1938
Henry W. Cook, M. D.	1938-1939
Harold M. Frost, M. D.	1939-1940
Donald B. Cragin, M. D.	1940-1941
David E. W. Wenstrand, M. D.	1941-1942
William Bolt, M. D.	1942-1945
Samuel J. Streight, M. D.	1945-1946
Albert O. Jimenis, M. D.	1946-1947
Albert J. Robinson, M. D.	1947-1948
Edwin G. Dewis, M. D.	1948–1949

OFFICERS OF THE ASSOCIATION

Vice-Presidents

Gurdon W. Russell, M. D.	1889-1892
Lewis McKnight, M. D.	1889-1892
John W. Fisher, M. D.	1892-1895, 1902-1904
H. Cabell Tabb, M. D.	1892-1897
Frederick W. Chapin, M. D.	1895-1896
Joseph H. Webb, M. D.	1896-1899
George R. Shepherd, M. D.	1897-1899
Edward H. Hamill, M. D.	1899-1902
Morris L. King, M. D.	1899-1902
Thomas H. Willard, M. D.	1902-1908
Oscar H. Rogers, M. D.	1904-1906
George Wilkins, M. D.	1906-1910
Robert L. Lounsberry, M. D.	1908-1909
George A. Van Wagenen, M. D.	1909-1910
Brandreth Symonds, M. D.	1910-1911
Harry Toulmin, M. D.	1910-1912
Edward K. Root, M. D.	1911-1913
William E. Porter, M. D.	1912-1914
Franklin C. Wells, M. D.	1913-1915
Homer Gage, M. D.	1914-1916
Walter A. Jaquith, M. D.	1915-1917
Arthur B. Wright, M. D.	1916-1918
Thomas H. Rockwell, M. D.	1917-1918
Faneuil S. Weisse, M. D.	1918-1919
Augustus S. Knight, M. D.	1918-1920
Thomas F. McMahon, M. D.	1919-1921
Frank L. Grosvenor, M. D.	1920-1922
William R. Ward, M. D.	1921-1923
Chester F. S. Whitney, M. D.	1922-1924
Angier B. Hobbs, M. D.	1923-1925
Wesley W. Beckett, M. D.	1924-1926
Robert M. Daley, M. D.	1925-1927
J. Allen Patton, M. D.	1926-1928
William Muhlberg, M. D.	1927-1929
Robert L. Rowley, M. D.	1928-1930
Charles L. Christiernin, M. D.	1929-1931
Lawrence G. Sykes, M. D.	1930-1932
H. Crawford Scadding, M. D.	1931-1932
Robert A. Fraser, M. D.	1932-1933
Fred L. Wells, M. D.	1932-1934
Eugene F. Russell, M. D.	1933-1935

OFFICERS OF THE ASSOCIATION

Vice-Presidents — Continued

Chester T. Brown, M. D.	1934-1936
Samuel B. Scholz, M. D.	1935-1937
Henry W. Cook, M. D.	1936-1938
Harold M. Frost, M. D.	1937-1939
Donald B. Cragin, M. D.	1938-1940
David E. W. Wenstrand, M. D.	1939-1941
William Bolt, M. D.	1940-1942
Samuel J. Streight, M. D.	1941-1945
Albert O. Jimenis, M. D.	1942-1945
Albert J. Robinson, M. D.	1945-1947
Edwin G. Dewis, M. D.	1946-1948
Harry E. Ungerleider, M. D.	1947–1949
Lauritz S. Ylvisaker, M. D.	1948-
Linford H. Lee, M. D.	1949–

Secretaries

Frank Wells, M. D.	1889-1891
Elias J. Marsh, M. D.	1891-1894
Oscar H. Rogers, M. D.	1894-1900
Brandreth Symonds, M. D.	1900-1907
William E. Porter, M. D.	1907-1912
Faneuil S. Weisse, M. D.	1912-1918
Angier B. Hobbs, M. D.	1918-1923
Chester T. Brown, M. D.	1923-1931
Edwin G. Dewis, M. D.	1931-1946
Henry B. Kirkland, M. D.	1946-

Treasurers

John W. Brannan, M. D.	1889-1899
Frank S. Grant, M. D.	1899-1903
Augustus S. Knight, M. D.	1903-1918
Charles L. Christiernin, M. D.	1918-1929
Albert O. Jimenis, M. D.	1929-1942
Walter A. Reiter, M. D.	1942-

Editors of the Proceedings

Angier B. Hobbs, M. D.	1917-1918
Robert M. Daley, M. D.	1918-1923
Eugene F. Russell, M. D.	1923-1928
Albert O. Jimenis, M. D.	1928-1929
Robert A. Fraser, M. D.	1929-1932
Samuel B. Scholz, M. D.	1932-1935
Harold M. Frost, M. D.	1935-1937
Harry E. Ungerleider, M. D.	1937-1947
James R. Gudger, M. D.	1947-

Transactions of The Association of Life Insurance Medical Directors

FIFTY-NINTH ANNUAL MEETING

The Fifty-ninth Annual Meeting of The Association of Life Insurance Medical Directors of America was held at the Hotel Statler in New York City on Thursday and Friday, October 19 and 20, 1950.

PRESIDENT UNGERLEIDER — Our regular scientific meeting will follow a report to the members of the Association presented by the Scientific Director of the Life Insurance Research Fund. He needs no introduction, and I am sure you will welcome a review of the Fund's work by Dr. Francis R. Dieuaide.

DR. DIEUAIDE — In June, at the meeting of the Medical Section of the American Life Convention, I gave a substantial summary of the work of the Life Insurance Medical Research Fund, and I will therefore not take your time to repeat a report of this work, since there has been nothing of special interest in the interim. I should like, however, with your indulgence, to make two brief announcements.

First, the Board of Directors of the Fund have arranged that the Fund will support a small working conference on the current status of research in one of the main problems of cardiovascular disease. The subject which has been selected for discussion by this conference is arteriosclerosis.

Since we are all most interested in the ultimate prevention of the disease, the deliberations will be focused on the causes, on work related to the causes, and mechanisms which result in arteriosclerosis. The ultimate aim in mind, of course, is

principally the prevention of coronary disease, since it is coronary disease that is the all too familiar expression of arteriosclerosis.

The immediate purpose is to bring together a number of the leaders in research in this field and thus endeavor to accelerate progress by the exchange of ideas about the significance of recent work and trends of present research. In order to obtain the maximum benefit from the conference, it will be necessary to restrict it to a rather small number of investigators who are actually working in the field and producing significant results. The date of the conference has not yet actually been selected. The proceedings will be published in full and will, of course, be made available to the medical officers of all companies, and to anyone else who is interested.

Secondly, I should like to tell you that a new and relatively extensive report of the work of the Fund is just now being printed and will be distributed to all of you within a few days. This report nominally covers in particular the period between January 1, 1949, and June 30, 1950. Care has been taken, however, to give a simple, comprehensive, and I hope an interesting, account of the results of work aided by the Fund since it was established in December, 1945. That will soon be five years ago.

I believe it will be found that a good account is given of the use of the $3,200,000 which have been allocated in this period for the support of 147 research programs, and 129 research fellowships. These have aided work in as many as 80 different institutions in both the United States and Canada. We will welcome most heartily all comments and criticism of this report.

PRESIDENT UNGERLEIDER — The scientific portion of our meeting this morning concerns itself with a major problem in American public health today, namely, arteriosclerosis. This condition contributes more than three-fifths of the deaths composing the mortality of all life insurance companies.

The first speaker to discuss arteriosclerosis is, like his illustrious father, Dr. George Dock, an eminent physician. Dr.

William Dock was born in Ann Arbor, Michigan, received his Bachelor of Science degree from Washington University, and his Doctor of Medicine from Rush Medical College in 1923. Since that time he has been house officer, Peter Bent Brigham Hospital in Boston, Associate Professor and Professor of Pathology at Stanford University, Professor of Pathology at Cornell University, and since 1941 Professor of Medicine at Long Island College of Medicine, now the State University of New York College of Medicine. He served as a volunteer with the French Army in the first world war and was decorated with the Croix de Guerre. In World War II he served as a Major with the United States Army. His investigations and researches are well known to the medical profession. Dr. Dock will speak to us on the "Prophylaxis and Therapy of Arteriosclerosis".

PROPHYLAXIS AND THERAPY OF ARTERIOSCLEROSIS

WILLIAM DOCK, M. D.

Professor of Medicine
State University of New York College of Medicine
New York, N. Y.

Ten or fifteen years ago this problem would have been considered ridiculous, because, for a long time pathologists and physicians regarded arteriosclerosis as a simple and inevitable degeneration of the vessels which was entirely comparable with the changing of colors of leaves in the fall. They believed this change was a degeneration similar to that occurring in the liver with cirrhosis, or in the brain with arteriosclerotic accidents; and the fat present in these vessels was regarded as a secondary result, a chemical transformation of substance in degenerating tissue.

It had already been shown, however, about a generation and a half ago, that the situation was not so simple as that. In the first place, most of the aging changes that we undergo, and that are so obvious from the outside, also occur in all sorts of species of wild animals. These are quite uniformly seen in all the various races of man, under whatever conditions they happen to live. This is true of the falling out of hair, and the graying of hair, and the wrinkling of skin, and other things recognized as aging changes. These include the changes in the joints which are apparent in fossil animals and in present day draft horses, as well as in the knees and spines of human beings.

Now, arteriosclerosis of the type that we are concerned with is not seen in wild animals at all, even when they happen to live to a very old age. Among the races of man it varies a good deal in its incidence and in some parts of the world is almost unknown. In Central Africa (Uganda), for example,

where the British have quite a good school of medicine, they have a fair autopsy experience on English people and others of Occidental background living in the region and eating their regular diets, partly in cans. They have also a very large experience in autopsy material among natives dying in their hospital for native people.

In the Western population living there they see the same sort of arteriosclerosis and deaths from coronary disease that we see, but in several thousand autopsies on adult black men who lived all their lives on the native diet, they saw practically no atheroma and only two cases in which death was supposed to be due to arteriosclerosis.

Similar differences in pathology of arteriosclerosis were reported by Snapper and others who worked at the Peiking Medical College. There was a very low incidence of arteriosclerosis in the northern Chinese.

There was some evidence from geographic pathology that this was not a universal and necessary degenerative change in the vessels, furthermore, as you know, it has become quite apparent in the last 15 years that arteriosclerosis is a metabolic disorder. The exact mechanism of its occurrence is still very obscure but we know it is not a degenerative change in the vessels.

One of the peculiar features of this metabolic disorder is the localization of the arteriosclerosis. Certain blood vessels, like the coronary arteries, show these changes relatively early in life. Among the hundreds of soldiers studied after death from coronary disease at the Army Institute of Pathology, it was noted over and over again that men dying under the age of 35 from coronary arteriosclerosis had the ordinary sort of atherosclerotic changes in both branches of the coronaries but often had no other atherosclerosis anywhere in their bodies. Hence, some vessels are unusually subject to atherosclerosis and so far we do not fully understand this localization of the disease.

It is also becoming clear that the levels of pressure in the vascular bed have a great deal to do with the development of atherosclerosis. In the abdominal aorta and the arteries of the legs, that is, in the region where blood pressure is high (because the pulse wave gets steeper and taller as it goes down the aorta and because there is hydrostatic pressure added to the ordinary pressure coming from the heart) arteriosclerosis is always far more severe than it is in the arms or in the mesenteric arteries. Therefore hypertension undoubtedly hastens the pace at which atherosclerosis occurs, but if one produces hypertension in a species in which atherosclerosis does not occur spontaneously, no atherosclerosis will occur from hypertension alone. It is an accelerating factor and not a causative factor, but anything which reduces hypertension will also postpone the date at which arteriosclerotic accidents occur. Therefore, we watch with great interest the study of hypertension as one of the most important features of efforts to devise better therapy and establish prophylactic measures to prevent the incidence of this disease.

Other local factors are quite well known to pathologists. For example, when there is syphilis of the aorta, arteriosclerosis of the aorta almost inevitably sets in. It shows up as chalky shadows in the x-rays of the ascending aorta. In North China this is not so. There syphilis of the aorta is common but the intima remains free of fatty changes because in that region atherosclerosis is relatively unknown.

So here, again, causes like local degenerative changes in vessels or congenital weakness in the walls of vessels would not produce atherosclerosis unless the situation were such that atherosclerosis is going to develop anyway.

This brings us then to the most important phase, the relation between the lipids in the blood and the incidence of atherosclerosis. It is perfectly clear from the experience in China and Malaya that when the blood cholesterol levels are below 150 mg. atherosclerosis does not develop in man. It is quite clear that in rabbits, where the blood cholesterol is 40 mg. it is absent under all conditions, hypertensive or otherwise, but

if the rabbit's blood cholesterol is raised by any method whatever by 100 mg. atherosclerosis sets in.

In dogs the normal blood cholesterol level is about the same as in man, ranging between 150 and 250, and in this species, atherosclerosis does not occur. But, if in some way the dog's blood cholesterol becomes increased over 400, atherosclerosis invariably occurs.

Now, various investigators, but notably Kendall and his co-workers here in New York, have shown that in all of these species, there is a fixed relationship between the cholesterol content of the blood and the phospholipid content. Whenever cholesterol rises, phospholipid rises also, but not quite so fast. As the ratio of cholesterol to phospholipid rises, up to a one-to-one molecular ratio, each species then enters the zone in which atherosclerosis can occur, and this level is very different in the rabbit, in man, and in the dog, because the basal levels are different. Therefore we are quite sure that the ratio of phospholipid to cholesterol is of vital importance.

This same problem is now approached by biochemists in much more complicated fashions. You probably all have read of Gofman's work, in which they skim off a cholesterol fraction with an ultracentrifuge and find that this light cholesterol is present in much greater quantities in people who have had recent vascular accidents, certainly due to atherosclerosis, and in the group that is predisposed to coronary disease. It is commoner to find high levels of this cholesterol fraction in men of middle age than in women of middle age, and it is commoner to find it in middle-aged people than in young people, and so on. Perhaps this light fraction that is skimmed off just represents the difference between the one-to-one cholesterol phospholipid ratios. We do not know.

Another important observation is that one of the lipid fractions of the blood is decreased in the people who get atherosclerosis. Workers at Cornell, with Dr. Barr, have shown that the alpha globulin lipoprotein tends to be low, and its percentage is quite low in people who have had recent coronary accidents and therefore are in the group obviously predisposed

to atherosclerosis. In other words, we have to deal not only with surplus but with deficit in lipid content of the blood in the scientific study of atherosclerosis.

It has been shown, of course, that certain substances like choline and methionine have effects on lipid metabolism, particularly in the liver. In some animal experiments they may alter the level of the phospholipid and of the cholesterol produced by other experimental changes. And, as you know, there are now many programs afoot for feeding people choline, inositol, lecithin, methionine, and also thyroid extract, because in animals thyroidectomy predisposes to high blood cholesterols. Thyroid excess lowers the blood cholesterol levels, so that thyroid feeding is now practiced in various ways by people who are interested in protecting patients from progressive atherosclerosis.

Now, all that we can say about this practically is that there is no good statistical information that any of these things are of much value. Dr. Gofman has shown that if a patient is given a low cholesterol, low fat diet, his strange fraction disappears from the blood very often and in a relatively short time. Many of us have seen that patients placed on low fat, low cholesterol diets experience a fall in their total blood cholesterol figures, and often quite a significant fall. This gives us some reason to believe that diet influences the level of blood cholesterol and perhaps the rate at which atherosclerosis progresses.

But all of this information is in a larval state, and Dr. Kendall tells me that some of the patients on the rice diet, which is fat and cholesterol free, had a rise in their light lipid fraction, and some of them had myocardial infarction occur while on the rice diet after having this fraction rise. So, apparently, there is no salvation from atherosclerosis even in an Oriental diet, which is fat and cholesterol-free. The situation is much more complicated than simply the effect of diet, although diet, obviously, has some effect.

Keyes and others have pointed out that in a general population the ordinary cholesterol intake cannot be correlated with

the level of blood cholesterol. There is so great a variation in the population that any effect diet may have is simply lost in the process when this is studied by taking dietary histories and comparing the probable cholesterol intake with the blood cholesterol levels. The problem of diet is certainly far more complicated than just high or low cholesterol intake, and it obviously is more complicated than just high or low fat intake, because the patient may get into trouble on a fat-free diet.

This brings us around to the fundamental problem which I believe no one has ever even attacked intelligently. What is the cholesterol in the blood doing and why is it maintained in various species at the various levels, and why does it fluctuate in some species with change in the diet but not in others?

Now, one might assume that cholesterol is just a substance that happens to be in the blood because the body is not able to get rid of it, and that the level of cholesterol merely indicates the inefficiency of the body in bringing it down to zero, which would be the ideal place. In other words, cholesterol can be thought of as something like a heavy urea which the body does not need at all, and what is present in the blood is only that which has not yet been eliminated. This thesis is almost certainly completely wrong and a better attitude would be to assume that cholesterol is like the dextrose in the blood. It is absolutely essential and the body has a very precise control over the level, and adjusts its level of cholesterol to the needs existing in that particular person, or in that particular species. One thing brought to our attention recently is of the utmost importance. When soap is injected intravenously into animals, in a very short time — a very few hours, even when the animal is on a cholesterol-free diet, the cholesterol level in the blood rises tremendously. The soap used is one of the organic detergents but it is quite probable that the same effect is produced with any soap or with saponin.

When this first dose of soap is given intravenously to a rabbit or dog the animal has considerable hemolysis. Within a few hours the blood cholesterol goes up. It may go from

40 to 1000 mg. in a rabbit in a couple of days. When the cholesterol reaches this new level, the second and third injections of the substance, as has been shown by the work of Kellner and his colleagues at Cornell, do not produce any more hemolysis. The cholesterol, apparently, and the phospholipids produced along with it, protect the animal cells from the injurious action of soap. It may be that the cholesterol normally present in the plasma is there for a definite protective purpose and the level of it is actually an indicator of how "soapy" we are inside.

This theory is supported by the fact that when we get jaundice of long-standing the blood cholesterol increases. Now, the bile acids are also detergents, or soaps in a sense. So, whenever the bile acid rises as a result of disease, the cholesterol levels go up too, and xanthoma may develop or cholesterol deposits may develop in connection with biliary cirrhosis of long duration. This, then, is further evidence that a different detergent, but a perfectly natural one, produces a rise in blood cholesterol.

When the serum albumin level falls, the protection of red cells from soaplike substances is greatly diminished. In diseases where the serum albumin falls, but with the liver in good working order, as in nephrosis or other conditions of low serum albumin, the blood cholesterol goes up to high levels. When the protection of albumin is absent it perhaps is supplemented by an increased level of cholesterol.

There are a number of other approaches that need study. Our diets may be made soapy in many other ways than by containing cholesterol or something of that nature. The foods that we cook are altered in cooking, and other substances are produced, acroleins, and similar products from fats which have soapy effects too. So that many other items in the diet which are not ordinarily considered harmful may turn out to evoke a rise in blood cholesterol simply by acting in the same fashion as soaps.

On the Kempner diet, the patient is given an enormously high intake of various kinds of fruit, compared with what,

let us say, the north Chinese would be taking, or the people in Uganda. They do not eat fruits the way people on a Kempner diet are given citrus juices. It may turn out that some people are sensitive to something derived from these fruits and hemolytic oils, and that they raise some cholesterol fractions as a result of this irritation. Although, in general, the total blood cholesterol tends to fall on a rice diet, in some patients at least, certain fractions may actually rise, and these fractions may be of considerable importance in relation to this problem.

When a patient comes with the practical problem saying "I come from a family where coronary disease is quite common, and I am now 40 years old, and I have had angina for the last six months. What can I do to postpone further coronary disease?" At the present time there is not any very definite answer, but there is some advice which I think will not be harmful.

In the first place, if he has hypertension, this must be treated seriously, even though his heart is normal in size, the eye grounds are normal, and he has normal renal function. Various procedures, some of them fairly annoying to the patient, may be recommended in this case, because of the impression that hypertension will accelerate the rate of vascular bed deterioration.

In the second place, advise this patient to change his diet so that his weight will steadily, although not rapidly, diminish and thus return to the ideal weight it should have been at age 18. By this I mean to ignore the figures that have been so painfully collected to show what the average weight of people is as they age in a North American or European population. As people age muscle mass tends to atrophy. The central nervous system tends to atrophy, and that presents serious handicap as you age. The increase in weight that occurs in all these tables of population is what might be called "oily dropsy". None of it is muscle and none of it is brains, and none of it is doing any good.

We know this fat that accumulates has an effect on the rate at which atherosclerosis develops. The best evidence for that is the work done in the Banting Institute where it was shown that if rabbits are put on a cholesterol feeding which raises their blood cholesterol and precipitates atherosclerosis in this species, the severity of the atherosclerosis that develops depends on whether a fat rabbit, or a thin rabbit, is used and whether the rabbit gains or loses weight during the period of the cholesterol feeding. This work has been published in the last year and obviously is of considerable importance in showing how obesity influences the body metabolism and leads to atherosclerosis when blood cholesterol levels are elevated.

We can be quite sure the elimination of obesity is a step in the right direction. There already was evidence of this in the work of Eckstein and Schoenheimer showing that the cholesterol turnover was always increased by giving the animals a high fat diet or one on which they gained weight, even though this was cholesterol free, and perhaps most of the calories were coming from carbohydrates. Then, advice to the patient to alter his diet, maintaining a good protein intake but lowering total caloric intake, particularly the fatty content, is a useful bit of advice.

Now, it is probable that fats of vegetable origin are the best forms to take. But it is unwise to consume large amounts of peanut or olive oil, because one cannot lose weight on such a diet. The unsaturated fatty acids are the most useful in the body's economy, and if the fat intake is to be low, the fats included in the diet should be largely vegetable fats with a fair degree of unsaturation. It is probably wise, also, to advise such a patient to restrict his salt intake as much as possible without upsetting his appetite and disturbing his diet too much. The reasons for that are quite simple, I think. All these people are predisposed, eventually, to having cardiac accidents of one sort or another and when heart disease develops they have to learn to live on a low salt diet. The other reason is that every night when lying down, salt water is shifted from our legs into the upper part of our bodies. Some

persons who are on high salt diets are quite well aware of the fact that their eyes are puffy in the morning when they get up, this having disappeared at night when they go to bed. This shift of edema fluid into loose tissue obviously takes place in atheromas. They may be described as loose, soft tissue in the blood vessels, and if at night, the bulk of orbital tissues is increased by 10 per cent, there is a good chance of increasing the bulk of the atheroma by 10 per cent. In doing that, it may make the difference in having a lumen and having no lumen at some place where the atheromas project out into the lumen of the vessel a fair distance. I think the reason so many people are first aware that they have coronary disease in the early morning hours is associated with this hydration of the aortic and coronary intima. They then have all the tissues in the upper part of the body in a puffy condition, which takes place when people on a high salt intake lie down for seven or eight hours of rest.

The high incidence of the first symptoms of coronary disease having their onset at a time when the patient is quite at rest, or when he first begins to get active in the morning, and when the hydration in the upper parts of the body is maximal is well known. A low salt intake and an adequate protein intake seem to be the essentials of the diet recommended for the management or prophylaxis of atherosclerosis.

Only those patients who have striking drops in their basal metabolic rates should be given thyroid extract. One reason for not giving it with normal basal rates is that nothing happens. Large amounts of desiccated thyroid may be administered to a patient with normal thyroid function, and the basal rate will not rise. In some observations we have made, this has no effect on the level of blood cholesterol once that is stabilized on any given diet.

Thyroid extract should not be given as part of a "shotgun mixture" which is going to be put on the market by dozens of firms. These geriatric medicines, of course, consist of multivitamins, choline, and thyroid extract, already being marketed by various firms. At the present time there is no

evidence that these medications really do what they are supposed to do and some of them may be harmful to some patients.

Very careful study on the value of these lipotropic agents is necessary in patients who either have their diet and weight changed not at all, or who have become stabilized after changing their diets, and so far this has not been done. Dr. Morrison reported that coronary disease has diminished 80 per cent in a group of patients who were fed choline after having myocardial infarctions. The next episode occurred only in a fifth of these patients as compared with controls. As he does not give us the figures for the weights of these patients at the beginning and end of the regimen, we do not know what this means. Those physicians who have tried to take 25 or 30 grams of choline a day are probably aware of the fact that it is one way of putting a patient on a diet. Some people get a persistent sense of nausea from these huge or unphysiologic levels of lipotropic agents. It is therefore quite possible that these substances may act to make it easier for the patient to lose weight by diminishing his appetite and giving him what always follows loss of appetite from any cause, whether it is tuberculosis, gallbladder disease, or nervous indigestion — a distaste for fatty foods. This is a normal reaction to any kind of indigestion. It may be that large doses of choline tend to alter the dietary selection of patients and their caloric intake. This, so far as I know, was not controlled very carefully in the study that has been reported.

The ideal patient who follows advice will follow the sort of diet recommended, and will watch his weight, losing weight steadily until he reaches the ideal weight for a person of his body build at the age of maturity, that is, 18. He may even go a little below this, because the person of 18 needs some fat to act as protection from pulmonary tuberculosis not so necessary in older people.

The weight should be brought down to the highly efficient athletic level of skin, bones, and muscle. This will take time, and during this time, the patient should always be getting an adequate intake of protein and water soluble vitamins. During this time, his blood cholesterol levels will be watched, and if

they tend to fall, one may feel that the diet is probably a step in the right direction. If they are maintained at levels above 200 in a patient with stabilized weight and blood cholesterol, it may be well, after six months, to see whether thyroid extract or lipotropic agents in reasonable doses will have any effect on his blood cholesterol levels. Even if they have no effect on these, they might theoretically affect the rate at which atheromas form; hence we cannot say that because the blood cholesterol does not fall, no prophylactic effect is being exerted.

But the statistical evidence to show there is a prophylactic effect when there is no change in the blood lipids will take quite a while to accumulate, and at the present time, as far as I know, no one is at work on precisely that problem. There are a great many problems still ahead of us in evaluating what should be done in the prophylaxis and in the therapy of atherosclerosis. At the present time, the most that we can say is that by placing the patient on a good physiologic diet, one which maintains body weight at the ideal for a person of his body build, and one which gives him a good liberal protein intake, certainly will do him no harm at all. Reduction of salt intake from the fantastically high unphysiologic level of sodium intake common with us to the level on which native peoples exist where salt is not easily available may offer him some protection from vascular accidents, both cerebral and coronary, by diminishing the edema of the atheroma that tends to occur after he has been recumbent for some hours while on a high salt intake.

Probably the rate at which atherosis occurs is also accelerated by this edema. So, when one is carrying out any prophylactic regimen, a low salt intake seems to me just as much a part of the regimen as a low calory or low fat diet. Precisely what other factors in our diet are harmful we do not know yet.

I hope no one will discover that the food should not be cooked, because I personally have never liked the idea of living on a "rabbit diet" in order to avoid atherosclerosis or anything

else. If it turns out that food should not be cooked, I think some of us will continue to regard atherosclerosis as a benefactor of the race, removing the elderly population and thus giving the younger ones opportunity, and those so minded will devote themselves to good cooking.

PRESIDENT UNGERLEIDER — Thank you, Dr. Dock.

DR. JOHN E. BOLAND — I am very much interested in knowing if Dr. Dock has a simple method that can be used by the life insurance companies, and by an ordinary laboratory, for determining the amount of blood cholesterol.

DR. DOCK — The methods for determining blood cholesterol are not entirely satisfactory in the hands of most laboratories, and it now appears that what we should have in each case is the phospholipid level and the cholesterol level. One of the firms marketing sure cures for geriatrics offers to do blood cholesterol determinations for doctors for two dollars. So far as I know, they have not offered to allow us to send them, from time to time, known preparations of human albumin and weighed-out cholesterol to see how well they are doing.

Cholesterol determinations are not simple. There are two methods mostly in use now. Neither one is simple or gives good results day in and day out, even in the hands of experts. We must admit that cholesterol determinations are also, at the present time, in an unsatisfactory state, and that to really size up the situation in any research program, it is necessary to have both the cholesterol and the phospholipid levels. In addition, Dr. Barr would determine the alpha globulin, and Dr. Gofman would add an 11,000 r. p. m. centrifuge to skim off the 10/20 fraction. That looks like a very bad program, and I think that all that most of us can do is have blood cholesterol determinations made in the laboratory which uses either the Bloor or the Sperry-Schoenheimer method. The Bloor method gives results 20 per cent higher in number, but one easily becomes accustomed to allowing for this and simply classifies the patients as to where they belong in the range of distribution based on the Sperry-Schoenheimer method.

Whenever anything of this sort is going on, there should be thrown in with the blood specimens that go to the laboratory every day a half dozen tubes that have the same sort of numbers on them, containing standard cholesterol solution, and serum albumin that has no cholesterol in it. These appear to be plasma and process like plasma, but the results are a check on that day's work. This method has been used in making vitamin and other determinations. No matter how skillful the laboratory is, it is essential that it process a range of knowns each day for the person who gets the reports. In this way one can judge whether that day's work is dependable.

This is a painful business, and it is annoying to technicians, but good technicians are glad to have this check on the standard of their work and it keeps their range of error down to a minimum.

Dr. Karl W. Anderson — Dr. Dock, I want to thank you for a very stimulating talk. The only question in my mind is that invariably, women are overweight after the age of 40, and yet cardiovascular disease does not seem to be as prevalent among older women as it is with men. Would you say a few words about that?

Dr. Dock — That, of course, is one of the great problems. The figures on cholesterol indicate that men and women have about the same cholesterol spread. Women certainly have no less hypertension than men have, so that the two main factors that we know on a statistical correlation seem to be the same in men and women. From autopsy observations, the abdominal aorta seems to age almost as rapidly in women as it does in men. Dr. Gubner knows more about that than I do, and he will probably tell you about it in a few minutes.

The sclerosis of the abdominal aorta is perhaps the best indicator to the tendency of the atherosclerosis.

Some years ago, I made some observations that made me think that the coronary arteries were not built as well in men as were the ones in women, and there is some confirmation of this in a paper by Helwig, and another by Metkofsky here

in New York. A very careful study of the coronary vessels of newborns in process at Los Angeles in a pathology department fails to confirm my original observation, so I no longer can say with great firmness that the reason men have far more coronary disease in any given decade than women is that their coronary arteries from birth have thicker intimas and are more subject to deposition of cholesterol. I am not sure it begins at birth. I am reasonably sure that at maturity men have thicker coronary intimas than women. From then on, coronary atherosis will occur. The bigger the intimal cushion, the faster it will develop.

The incidence of coronary disease cannot be used as the only criterion of the incidence of atherosclerosis in the adult population. Sclerosis of the abdominal aorta may go to a far advanced stage without the patient having any symptoms or illness. I really do not know what the difference is between the sexes. Five years ago, I could have told you without any trouble at all.

Dr. Paul H. Langner — I should like to ask Dr. Dock if it is harmful to eat egg yolk, or is there enough effect to counteract the effect of lipid? What do you consider a top normal cholesterol by either method?

Dr. Dock — I would say that if the blood cholesterol is always under 160, one can be sure of not getting atherosclerosis. However, one may acquire vitamin A deficiency.

If the blood cholesterol is over 180, one can develop atherosclerosis, and the pace at which it develops probably is related to the height of the blood cholesterol, among other things. People with levels of 300, presumably, will have more coronary disease before 50 than people with blood cholesterol of 220. There is some evidence that this is true in studies made in various parts of the country.

As to the egg yolk, I do not think anybody knows now whether the ingested cholesterol has anything to do with the blood cholesterol. In the rabbit, it has; in the dog, without adequate thyroid function, the level in the diet determines the blood cholesterol level. Under some conditions, the diet in-

fluences blood cholesterol. Other factors may be so much more important. It may turn out that when a fried egg, containing well heated cholesterol, is fed to rabbits they will develop far worse atherosclerosis. The cooking of the egg may have more to do with its effect on human anatomy than the fact that there is cholesterol or fat in it.

Unfortunately, we do not know any of these points now, but we do know that body weight cannot be reduced on a diet that contains many egg yolks. Egg yolks and butter are very fattening substances, and I think it is almost automatic that a patient on a reducing diet must eliminate the things that a normal native person would not get. Now, natives get eggs only in season, and the season is very short out in the woods. Birds do not lay eggs all year round unless they are kept in barns, so eggs are not a normal part of any mammalian diet over any long period of time. I think that keeping people on milk and eggs all the year around is, in a sense, highly unphysiologic. Milk has good protein in it, but the less of the fat of the milk adults get, the better. The eating of ice cream or butter affords great enjoyment but may result in harm. On the other hand, those pleasant items in the diet may be helping to hasten the creation of a vacancy for somebody else who wants your job.

PRESIDENT UNGERLEIDER — We shall continue our program with another paper on the subject of arteriosclerosis, by Dr. Richard S. Gubner, Assistant Medical Director, The Equitable Life Assurance Society of the United States.

THE DIAGNOSIS OF ARTERIOSCLEROSIS INCLUDING OBSERVATIONS ON LIPID METABOLISM AND THE BALLISTOCARDIOGRAM

RICHARD GUBNER, M. D.
Assistant Medical Director
The Equitable Life Assurance Society of the United States
New York City

The diagnosis of arteriosclerosis is usually made in advanced stages only after it has caused drastic reduction in blood supply to organs such as the heart, the brain, or the lower extremities, producing symptoms and signs indicative of impaired organ function. Various tests are available to investigate the adequacy of blood flow to individual organs, e. g., the electrocardiogram and the electrocardiographic response to exercise, the fusion flicker test which indicates the adequacy of blood flow to the retina, and a variety of tests reflecting the state of the circulation to the extremities. Such tests indicate only that the organ function is impaired associated with a reduction in blood flow; they do not actually demonstrate the presence of arteriosclerosis. A diagnosis of arteriosclerosis can be made directly only in the retinal vessels and by x-ray demonstration of calcification of the large vessels. Examination of the retinal vessels for arteriosclerosis requires considerable application and skill and is a subjective method, and accordingly its utility is somewhat limited. It has long been known to pathologists that arteriosclerosis of the atherosclerotic type is most prevalent and most marked in the abdominal aorta and iliac arteries. The present study was undertaken to determine the feasibility and utility of the demonstration of arteriosclerosis in these vessels in the clinical diagnosis of arteriosclerosis.

The material comprising this study includes 320 consecutive unselected insurance applicants over the age of thirty-five

examined in the diagnostic laboratory of the Equitable Life Assurance Society of the United States during 1949 and 1950. A cardiovascular survey was carried out on these subjects because of the amounts of insurance applied for, the presence of glycosuria, slight elevation of the blood pressure, and miscellaneous borderline findings such as extrasystoles, tachycardia, murmurs, or questionable history. Very few subjects with a known background of organic heart disease were examined, and the few cases in which examination was performed because of previous findings such as an unfavorable electrocardiogram, enlarged heart, or calcified aorta were excluded from the series analyzed.

The study carried out in each individual included history, physical examination, teleoroentgenogram of the chest in the frontal and left anterior oblique positions, roentgenkymograms, electrocardiogram including unipolar extremity leads, and serial precordial V leads, lateral roentgenogram of the abdomen (150 m. a. s., 75–90 kv.), and a frontal view of the pelvis permitting observation of the iliac and femoral arteries (100 m. a. s., 66–76 kv.). Glucose tolerance tests were performed in all subjects with glycosuria, and in the majority of these serum cholesterol was determined by the Kendall modification of the Schoenheimer-Sperry method (1). The following signs were considered to indicate the presence of the atherosclerotic type of arteriosclerosis: 1) the presence of definite calcified plaques in the abdominal aorta, iliac artery, or aortic knob; 2) major electrocardiographic abnormalities such as bundle branch block, Q waves signifying previous infarction, or advanced T wave abnormalities; 3) reversal of pulsation along the left ventricular border in the roentgenkymogram; lesser degrees of abnormalities in the roentgenkymogram were not considered as positive evidence of vascular disease. Diagnosis of the medial type of arteriosclerosis was made in the iliac and femoral vessels by the presence of tubular calcification of segments of these arteries. Observation was also made of tortuosity and widening of the aortic arch employing the Sheridan index (2) which relates the transverse diameter of the aortic arch to weight, height, and age.

Table 1 indicates the frequency of the finding of arteriosclerosis with the various individual criteria employed in this study of 320 subjects. Calcification of the abdominal aorta was present in 77 cases, two and a half times more frequent than any other sign of arteriosclerosis. Definitely abnormal electrocardiograms were present in 30 subjects, calcified iliac

TABLE I

SIGNS OF ARTERIOSCLEROSIS (320 CASES)

	Total	Alone	In Combination
Abdominal Aorta	77	40	37
Iliac Arteries	20	4	16
Aortic Knob	15	7	8
Electrocardiogram	30	12	18
Kymogram	8	5	3
Medial Sclerosis	32	11	21
Wide Aortic Arch	30	9	21

vessels of the atherosclerotic type in 20 cases, calcification of the aortic knob in 15 cases, and a reversal of pulsation in the kymogram in 8 cases. It is seen also in this table that in the majority of cases abnormal electrocardiograms and calcification of the iliac vessels and of the aortic knob occurred most frequently in association with other signs of arteriosclerosis, and were less commonly present as isolated findings. The medial type of arteriosclerosis as seen in the iliac and femoral vessels was observed in 32 cases, and tortuosity of the aortic arch in 30 cases. These, too, also occurred more commonly in association with other signs of arteriosclerosis.

Figure 1 indicates the age distribution of the 320 subjects studied and the incidence of arteriosclerosis in each age group. Medial sclerosis occurred more frequently than indicated in this graph. Where it occurred in association with atherosclerosis the case was included in the atherosclerotic group. The cases comprising the groups with atherosclerosis

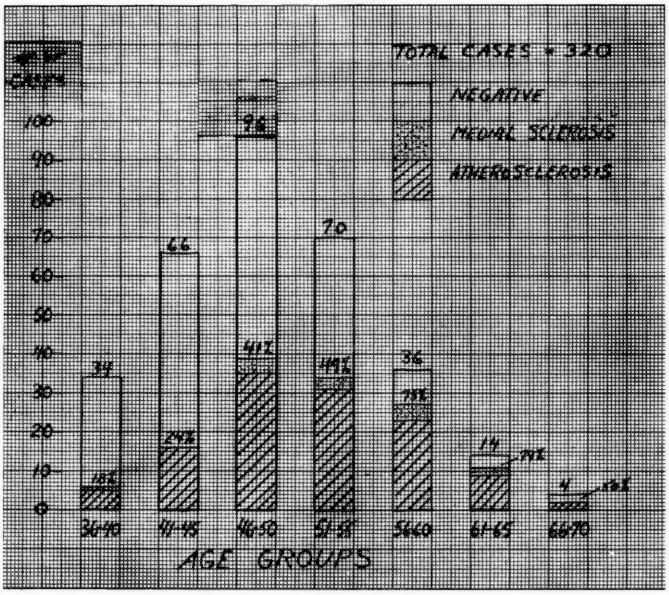

Figure 1.
Age distribution and incidence of arteriosclerosis.

included all subjects with one or more signs of atherosclerotic arteriosclerosis mentioned above. The increase in incidence of arteriosclerosis with advancing age is clearly evident in this graph. Arteriosclerosis was found in fully half of subjects between the ages of 51 and 55 and was present in 75 per cent of cases above the age of 55. A further analysis of the cases observed is shown in Figure 2 where the incidence of arteriosclerosis in various age groups is analyzed in three groups: 1. those with slight elevation of the blood pressure, and it should be emphasized that the blood pressure was within insurable limits in all subjects (53 cases), 2. subjects with glycosuria (82 cases), 3. subjects studied for miscellaneous reasons such as amount of insurance applied for, extrasystoles and various other borderline findings (185 cases). It is seen

in this graph, as is well known, that both hypertension and diabetes accentuate the development of arteriosclerosis. All nine cases with glycosuria between the ages of 56 and 60 showed evidence of arteriosclerosis and all seven subjects with

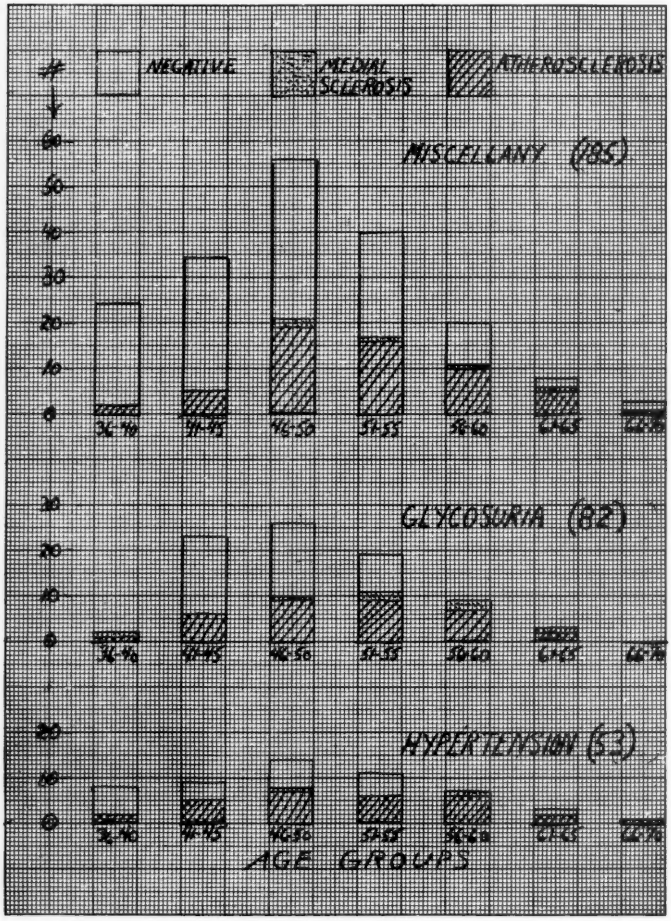

Figure 2.
Age distribution and incidence of arteriosclerosis in subjects with slight hypertension, glycosuria, and miscellaneous borderline findings.

elevated blood pressure in this age group similarly showed evidence of arteriosclerosis, compared to an incidence of 11 among 20 total cases in the same age group in individuals who had neither high blood pressure nor glycosuria.

The frequency with which a diagnosis of arteriosclerosis can be made clinically, as indicated by this study, is of interest, but the findings that the frequency of arteriosclerosis increases with age, with hypertension, and with diabetes, are scarcely novel or unexpected. Two other observations, however, revealed by study of the data, are of some interest. Exact weight and height were determined in all subjects, permitting an analysis of the relationship of body build to arteriosclerosis (Table 2). This analysis was confined to subjects under the age of 55, and to those who did not have either elevated blood pressure or glycosuria. This was done to exclude the factors which are known to contribute to the development of arteriosclerosis, namely, age, elevated blood pressure, and diabetes. Of 41 cases with atherosclerosis thus studied the average body build was 9.3 per cent overweight. Among 94 cases of similar type with no evidence of atherosclerosis the average body build was 7.8 per cent overweight. The difference is so slight as to appear insignificant, and lays open to doubt the widely held view that obesity of itself predisposes to the development of arteriosclerosis. It may well be that whatever relationship obesity bears to arteriosclerosis is an indirect and remote one, mediated by the greater incidence of hypertension and diabetes in obese individuals.

TABLE II

OVERWEIGHT AND ARTERIOSCLEROSIS

	# CASES	% OVERWEIGHT
Atherosclerosis	41	9.3
No Atherosclerosis	94	7.8

(All subjects under age 55, normal blood pressure, no glycosuria)

A further observation of interest has been an analysis of the relationship of blood cholesterol to arteriosclerosis. Deter-

mination of blood cholesterol was carried out in 53 subjects with glycosuria. Table 3 illustrates the incidence of arteriosclerosis according to the level of blood cholesterol. Even though the number of cases is small, one finding is striking.

TABLE III

CHOLESTEROL AND ARTERIOSCLEROSIS

	under 150	150–199	200–249	250–299	over 300
# Cases	6	23	21	6	7
# with Arteriosclerosis	0	13	8	3	4
% with Arteriosclerosis	0	56.5	38	50	57
Average Age	47.2	48.7	48.4	51.2	49.0

A conspicuous absence of arteriosclerosis is evident in subjects with very low levels of blood cholesterol, i.e., under 150 mg. Above this low level of cholesterol the incidence of arteriosclerosis is fairly similar regardless of the level of cholesterol. These findings are confirmatory of the study we reported in 1949 before the American Heart Association (3). In this earlier study it was found among 612 subjects studied because of a finding of glycosuria on application for life insurance, that the incidence of arteriosclerosis of the aorta was approximately the same in (1) individuals with slight degrees of hypercholesteremia (average cholesterol 300 mg.) as in (2) those with "normal" cholesterol concentration (average cholesterol 211 mg.); whereas among subjects with low cholesterol levels (3) significantly less arteriosclerosis was found (average cholesterol 160 mg.). These observations, as well as the present findings, suggest that the so-called "normal" cholesterol is in reality a high cholesterol, and that the cholesterol level of the average American population is of such an order as to predispose to the development of arteriosclerosis. From a therapeutic and prophylactic standpoint it would seem that little of an effective nature can be anticipated until agents are found which will bring the level of blood cholesterol down to such low values as appear to afford protection against the development of arteriosclerosis.

In this investigation, comparing various methods for the detection of arteriosclerosis, the electrocardiogram would doubtless have been positive in many more instances, had exercise tests to reveal latent coronary insufficiency been carried out. The resting cardiogram is normal in the majority of subjects with organic angina pectoris. As we have emphasized elsewhere (4), examination of the heart is incomplete in subjects in whom coronary artery disease is suspected unless the electrocardiographic response to exercise is studied. Unfortunately, this was not a practicable procedure in the present study, and parenthetically it may be remarked that this test, valuable though it be, does not lend itself very well to survey studies, as in the examination of insurance applicants.

We should like now to give some consideration to another method of investigating cardiac function, particularly with reference to coronary disease. The principles of ballistocardiography have been known for many years and extensive physiological and clinical studies have been carried out by Starr (5), Hamilton (6), Nickerson (7), and other investigators. The complexity of the apparatus, however, precluded widespread clinical employment until the introduction by Dock (8) last year of extremely simple modifications, permitting ballistocardiograms to be recorded by an attachment to the electrocardiograph. Stated briefly, the principle of ballistocardiography is Newton's third law of motion, namely, for every acting force, there is an equal and opposite reacting force. What is recorded is the motion of the body in response to contraction of the heart, ejection of blood, and movement of blood in the great vessels.

Types of ballistocardiographs employed may record displacement of the body, or acceleration, as with the electromagnetic apparatus introduced by Dock. The frequency response varies with different instruments; that of Nickerson is a low frequency critically damped apparatus; others are undamped and record high frequencies. While the low frequency apparatus possesses certain advantages in fidelity, the movement of the base line due to the recording of the very low frequency movement of the body with respiration

makes reading of the record somewhat difficult unless respiration is suspended, and as will be presently indicated, the respiratory variations of the ballistocardiographic waves are of themselves of considerable significance. The more commonly employed high frequency type of apparatus causes certain artefacts, notably in one of the waves, the K wave, which may be markedly exaggerated. This is of some importance in conditions where the K wave is of interest, such as coarctation of the aorta and hypertension and arteriosclerosis. In addition to these factors, certain other electrical effects may cause distortion in wave form and amplitude, and phase shifts affecting timing.

Apart from the important influences of the recording instrument, there are other complexities. Although the waves may be correlated grossly with certain events in the cardiac cycle, the forces they represent are not pure but the summation of different vectors, in large measure oppositely directed. The type of ballistocardiograph generally employed records only forces in the longitudinal axis of the body. Fortunately the major forces associated with left ventricular ejection are exerted in this axis. Recently modifications have been introduced which record vectors exerted in other directions as well, similar to the development of vector electrocardiography (9, 10). Ballistocardiograms made in the recumbent position, which is the customary method, may differ in important respects from tracings made in the erect position. For proper identification of the ballistocardiographic waves, it is imperative to have simultaneous recording of other phenomena associated with the cardiac cycle, such as the heart sounds, electrocardiogram, or the pulse wave. It is essential to point out these circumstances pertaining to the recording of the ballistocardiogram, for unless they are fully appreciated, the interpretation of the ballistocardiogram is beset with pitfalls.

An obstacle to general clinical employment of the ballistocardiograph has been the necessity of employing a two-channel recording instrument so that the waves may be recognized and analyzed by orientation to known phases of the cardiac cycle. We have been able to surmount this obstacle

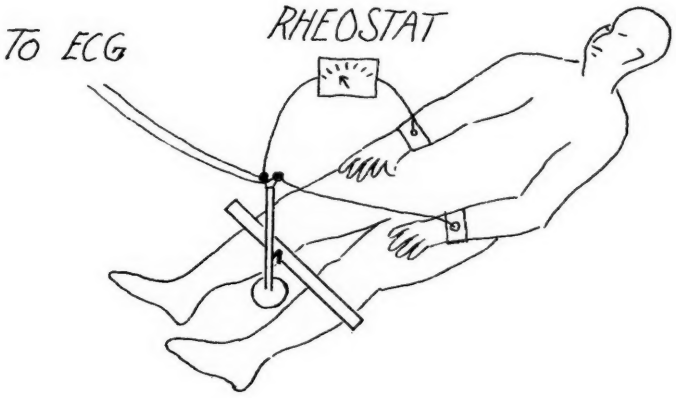

Figure 3.

Device for recording ballistocardiogram and electrocardiogram selectively on a single channel. Two electrocardiographic lead wires are hooked up with the ballistocardiograph terminals in parallel circuit, with a rheostat interposed in series in one of the electrocardiograph lead wires. Rheostat resistance is variable by dial from zero to one million ohms.

by a simple expedient illustrated in Figure 3 which enables the electrocardiogram and ballistocardiogram to be selectively recorded individually or together on a single channel. An electrocardiographic lead is connected in parallel circuit with the ballistocardiographic terminals with a rheostat with resistance of zero to one million ohms interposed in series in one of the electrocardiographic lead wires. With low resistances the electrocardiogram dominates, but as the resistance is stepped up the amplitude of the electrocardiographic waves decreases to a point where the QRS appears only as a small spike preceding the ballistocardiographic waves with each heart beat. This serves as a convenient reference for timing and identifying the waves of the ballistocardiogram. The appearance of the record with varying resistances is illustrated in Figure 4.

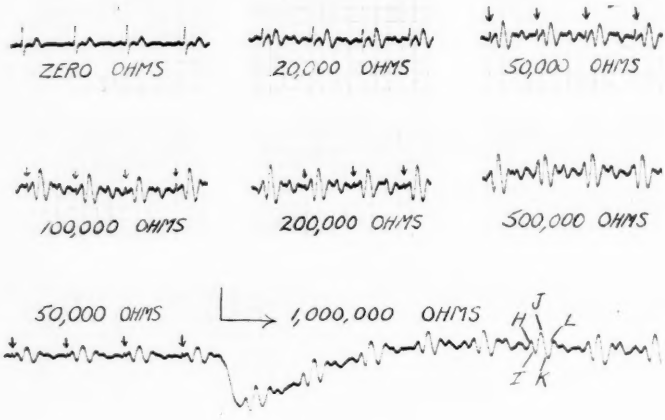

Figure 4.

Simultaneous recording of electrocardiogram and ballistocardiogram on single channel. At low resistances the electrocardiogram dominates. As the resistance is increased to 50,000 ohms and above, the amplitude of the QRS is markedly diminished so that the QRS complex is visible only as a small spike preceding the ballistocardiographic waves with each beat. This serves conveniently for timing and identification of the ballistocardiographic waves. In the lower record made on another subject, the resistance is abruptly switched during the recording, from fifty thousand to one million ohms. Note disappearance of the small QRS spike as the resistance is increased, so that a pure ballistocardiogram is now recorded.

For many years interest in ballistocardiography was focused by Starr and other investigators on the quantitative determination of the cardiac output. It is now recognized that, while the ballistocardiogram may be in some measure correlated with the stroke output, what it reflects is not the quantity of ejection but rather the velocity of ejection, and acceleration of blood in the aorta and great vessels. Literally, the ballistocardiogram is an index of the force of the heart beat, i.e., mass times acceleration, and provides by far the most sensitive method by which information regarding the force of the heart may be obtained.

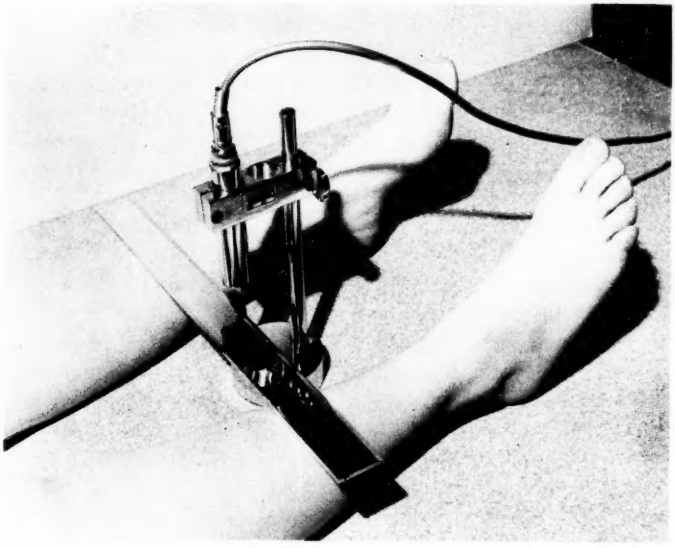

Figure 5.
Piezoelectric ballistocardiograph (courtesy of John Peck Laboratories). Recording is made on standard electrocardiograph.

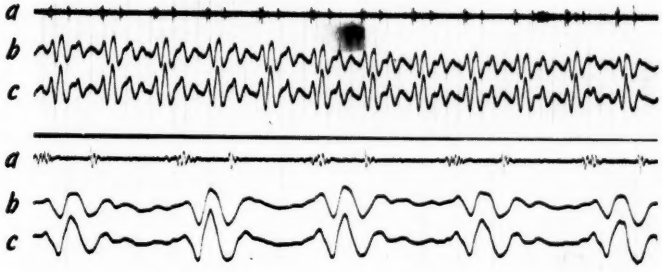

Figure 6.
Simultaneous recording of heart sounds (a), piezoelectric ballistocardiogram (b), and electromagnetic ballistocardiogram (c), Lower record is made at high speed.

The theoretic factors influencing the various types of recording instruments and the quantitative mathematical analysis of the various waves may be of interest, but the ultimate test of a method of investigating the heart and circulation is its empirical utility. To this end we have carried out comparative studies with three types of instruments: the electromagnetic apparatus kindly given us by Dr. William Dock, the piezo-electric ballistocardiograph described by Dr. George Sheehan and his co-workers (11), provided by Dr. A. J. Pacini of the John Peck Laboratories, and the photoelectric ballistocardiograph also introduced by Dr. Dock and now manufactured by the Sanborn Company. The latter instrument possesses a filter switch enabling the recording of either the high frequency undamped type of ballistocardiogram or the low frequency ballistocardiogram simulating the type of record obtained on the Nickerson table. Photoelectric, electromagnetic and piezo-electric ballistocardiograms are recorded in similar manner, as introduced by Dock. A bar is laid across the legs with the subject in the recumbent position and the movements of the bar are picked up with the recording instrument. In the piezo-electric unit a metal vertical cantilever strip placed against the bar compresses barium titanate crystals in the piezo-electric plates. The difference in the mechanical strain between the two plates generates a potential which is recorded by the electrocardiograph (Figure 5). Figure 6 illustrates a simultaneous record of the heart sounds, the piezo-electric ballistocardiogram, and beneath this, the electromagnetic ballistocardiogram. For practical purposes, the two types of recording are identical.

Figure 7 shows the Sanborn photoelectric instrument. In this a battery light source mounted in the cross piece over the legs actuates a photoelectric cell placed close by. Figure 8 shows simultaneous recording of the heart sounds, photoelectric, and electromagnetic ballistocardiograms. The top strip illustrates the low frequency type of record in which the slow respiratory movements are recorded producing a wavy base line. In the second strip, respiration is suspended and the base line is regular but a significant difference from the

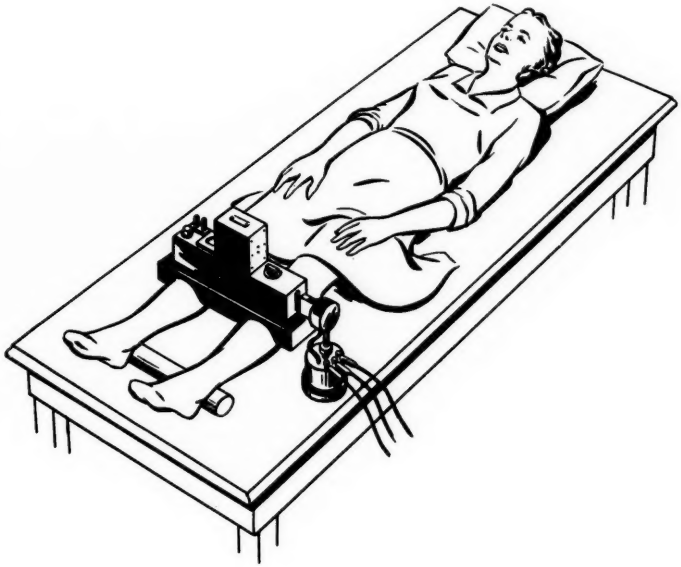

Figure 7.
Photoelectric ballistocardiograph (courtesy of Sanborn Company).

electromagnetic type of record is evident in that there is practically no K wave, whereas in the electromagnetic record a prominent K wave is seen. In the third strip, the photoelectric unit has been switched to eliminate low frequencies and respiratory movement is no longer observed. In this and in the fourth strip, with respiration suspended, it is seen that the photoelectric unit closely resembles the electromagnetic record. There is a slight time lag in the photoelectric pickup due to the fact that the photoelectric unit records displacement whereas the electromagnetic unit records acceleration. Practically all our records have been taken with the high frequency type of response which, despite certain artefacts produced in the K wave as already mentioned, has proven very satisfactory for clinical employment.

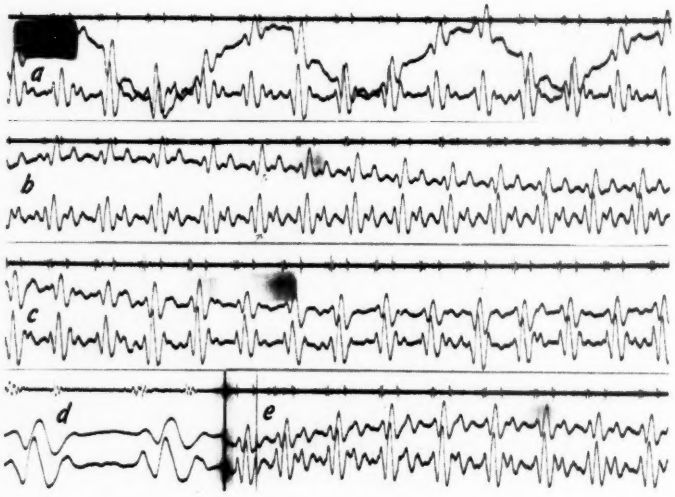

Figure 8.

Simultaneous recording of heart sounds, photoelectric ballistocardiogram, and electromagnetic ballistocardiogram. The top strip of records (a) - (e) is heart sound, center strip photoelectric and lower strip electromagnetic ballistocardiogram. In record (a) low frequencies are recorded in the photoelectric ballistocardiogram and a large excursion of the base line is seen. In record (b) taken with respiration suspended the baseline of the photoelectric record is steady. The K wave (indicated by arrow) is much smaller in the photoelectric than in the electromagnetic ballistocardiogram.

In record (c) low frequencies are filtered out of the photoelectric ballistocardiogram and the baseline is steady throughout respiration. In this record and in records (d) and (e) made with respiration suspended it is seen that photoelectric and electromagnetic records are practically identical.

In order to establish some basis for interpretation of the ballistocardiogram, it appeared essential to study a large series of normal individuals in various age groups, which we reported last June at the meeting of the American Heart Association (12). Ballistocardiograms were recorded simultaneously with heart sounds and the electrocardiogram employing the Sanborn tribeam apparatus in a series of 150 normal individuals from the second to eighth decade inclusive. Records were taken in the recumbent position at 25 mm. per

second, and 75 mm. per second film speed, during normal respiration, and also with respiration suspended in inspiratory and expiratory phases.

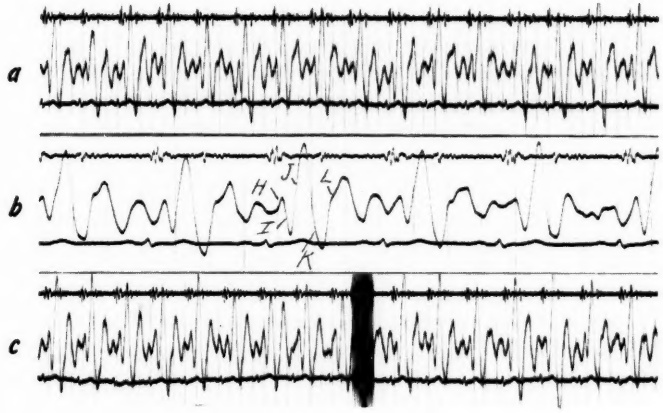

Figure 9.

Ballistocardiogram of young normal subject, age 25, with simultaneous recording of heart sounds and electrocardiogram. Strip (a) is taken during normal breathing, strip (b) is taken with high speed recording, and strip (c) is taken with respiration suspended first in inspiration, then in expiration.

Figure 9 illustrates a typical ballistocardiogram of a young normal adult male. Employing Starr's terminology of the waves, a small upstroke, the H wave, is seen synchronous with the first heart sound reflecting movement of the heart during the isometric phase of systole preceding ejection. This is followed by a prominent sharp downstroke, the I wave, associated with the initial phase of ventricular ejection of blood into the ascending aorta. This is then succeeded by a sharp upstroke which is normally the most prominent wave of the ballistocardiogram, the J wave. The J wave is produced by acceleration of blood flow in the descending aorta. The peak of the J wave is normally attained in 0.25 seconds or less from the beginning of the QRS complex of the electrocardiogram. Following the J wave there is a K wave downstroke which is due to deceleration of blood flow in the aorta as the

column of blood strikes the peripheral arteriolar resistance. As already mentioned in the high frequency type of recording, the K wave is greatly exaggerated. The trough of the K wave occurs 0.01 to 0.02 second before the second heart sound. Following the K wave there is a rebound L wave which is associated with closure of the aortic valve and the second heart sound. The L wave and succeeding after waves are not normally very prominent. One further feature to be observed is a modest variation in the amplitude of the complexes which vary with respiration, attaining greatest height in inspiration and smallest amplitude in expiration.

The H wave and the I wave are due not solely to left ventricular contraction but in part to the right ventricle as well, i.e., isometric contraction of the right ventricle contributing to the H wave and ejection of blood upward in the pulmonary artery contributing to the I wave. During the performance of the Valsalva test, in which ventricular filling, force of contraction and quantity of ejection are abruptly decreased, the H and I waves decrease in amplitude. The right ventricle does not contribute in any appreciable degree to the formation of the J wave, for right ventricular ejection following the initial thrust upward into the pulmonary artery does not act in a longitudinal vector but is directed laterally and in opposite directions toward the lung fields. The J wave, which reflects acceleration of blood in the descending aorta is due not solely to blood ejected from the heart in systole but also in important measure to acceleration of the blood column already present in the descending aorta. The aid given by gravity probably accounts for the heightened amplitude of the J waves in ballistocardiograms recorded in the upright position. The increased amplitude of the J wave in inspiration may be due to the greater volume of the aortic column of blood during inspiration. This is produced by phasic variations in arteriolar vasomotor tone, vasoconstrictor impulses during inspiration decreasing arterial emptying and increasing the aortic volume which receives acceleration during systole. Peripheral resistance is also an important determinant of the K wave which results from sudden decelera-

tion of blood flow as it meets the arteriolar resistance. When resistance is decreased as in vasodilatation of the lower extremities the K wave is reduced, conversely, when the resistance is high as in hypertension or when the aorta is inelastic a more abrupt deceleration of blood flow occurs with a deeper and earlier K wave. The L wave is in part due to rebound in the aorta, but this wave together with succeeding waves in early diastole is determined largely by venous inflow into the heart and is accentuated in circumstances of rapid diastolic refilling of the ventricle as we have observed in arteriovenous aneurysm and in mitral insufficiency. These diastolic waves may be more prominent in ballistocardiograms which record lateral displacement of the body as Dock has shown (13).

In older individuals who are presumably normal so far as we have been able to ascertain by routine examination, important changes in the ballistocardiogram develop, if not regularly, at least with great frequency. These include the following: 1) A decided increase in respiratory variation in amplitude. 2) The H wave becomes of much greater relative amplitude and may approach or at times even exceed the J wave. 3) The I wave becomes much shallower and may not be evident as a distinct stroke below the base line. 4) The J wave becomes lower in amplitude and may be slurred or notched. 5) The peak of the J wave is attained later so that the time from the onset of the QRS to the peak of the J may be as much as 0.28 to 0.30 second. 6) The K wave becomes deeper and earlier, so that it may antecede the second heart sound by more than 0.02 second. 7) The L wave becomes increased in amplitude and other after waves may similarly become more prominent. These variations in older subjects are most conspicuous in the expiratory phase during normal respiration. With the breath suspended in inspiration or expiration these variations are less conspicuous and the waves may resemble those seen in younger individuals. Usually in older subjects the complexes are more nearly normal with breath suspended in inspiration rather than expiration, but the converse may be true. Figure 10 illustrates ballistocardiograms in normal older individuals.

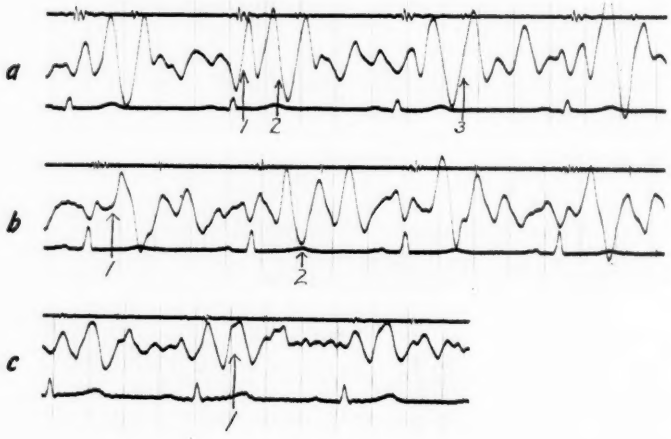

Figure 10.
Ballistocardiograms in three older normal subjects, exhibiting various abnormalities.
a) age 58. 1. Large H wave. 2. Deep K wave. 3. Large L wave.
b) age 56. 1. Absent I wave. 2. Early K wave.
c) age 65. 1. Slurred, low amplitude J wave.

Recognition of the frequency with which aberrations in the ballistocardiogram occur in older subjects is important, for precisely the same type of changes, frequently in accentuated degree, occur in coronary artery disease as illustrated in Figure 11. It is evident that the effect of coronary artery disease on the ballistocardiogram cannot be investigated with any degree of validity or certainty in older individuals. Accordingly we have directed our attention to a study of ballistocardiographic changes in young subjects with coronary artery disease in an age group where the variations described above do not normally occur. Figure 12 illustrates the tracings of a young physician age 34, previously an intercollegiate track champion, who sustained an extensive anterior wall infarct two months before the tracing was made. Respiratory variation is marked, the H wave is prominent, practically no I wave is seen, the J wave is reduced in amplitude and is slurred,

and there is a prominent L wave. With respiration suspended in inspiration and expiration, these abnormalities are less marked. Figure 13 is that of a subject of 33 with an anginal syndrome due to coronary insufficiency as demonstrated by an electrocardiogram made after exercise. Respiratory variation is considerable, H wave is prominent, I wave shallow and the J wave notched. The tracing made five minutes after exercise shows these abnormalities in even more accentuated degree.

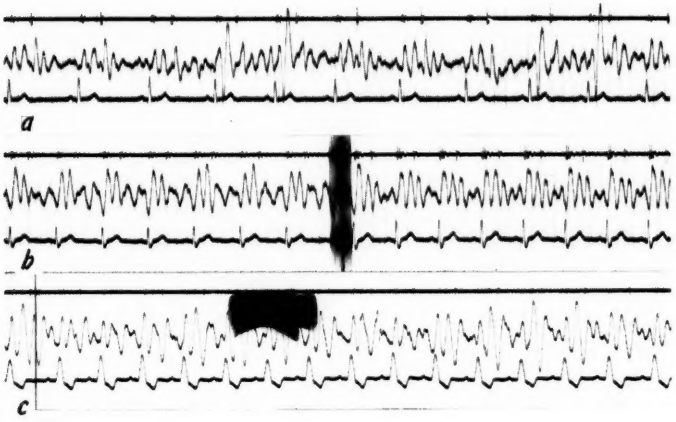

Figure 11.

Ballistocardiograms in three subjects with arteriosclerotic heart disease (a) male age 62, (b) male age 61, (c) male age 57.
Respiratory variation is marked in records (a) and (c).
H wave is of large amplitude in (a), (b), and (c).
I wave is phasically poor in records (a) and (c), and in record (b) made with respiration suspended first in inspiration then in expiration.
J wave is delayed in records (a), (b) and (c). The peak of J is attained 0.28 seconds after onset of QRS in (a) and (b) and 0.30 seconds after onset of QRS in (c) where left bundle branch block is present.
J is phasically slurred, notched and of low amplitude in record (c).

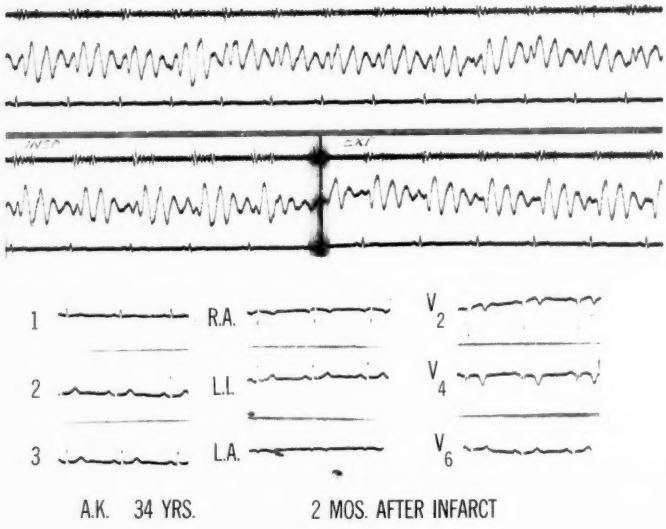

Figure 12.

Ballistocardiogram of male, age 34, taken two months after attack of anterior wall infarction. Respiratory variation is considerable, the H wave is large, the I shallow, J slurred and delayed in attainment of its peak, L wave is prominent. With respiration suspended in inspiration and expiration the abnormalities are less marked and the waves are of relatively normal configuration.

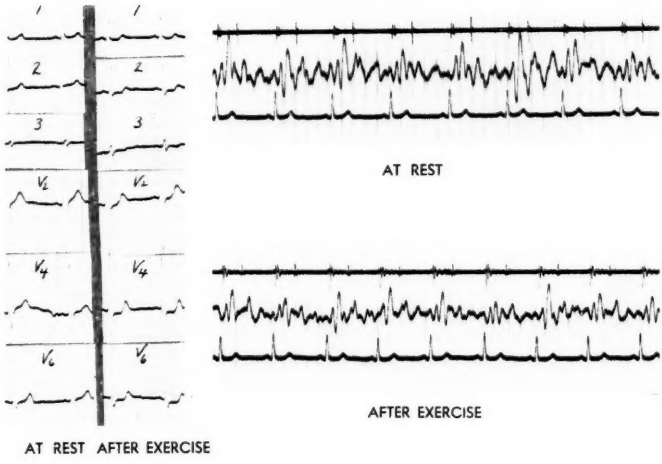

Figure 13.
Effect of exercise on ballistocardiogram and electrocardiogram in male, age 33, with angina pectoris.
Electrocardiogram, normal at rest, showed depression of ST segment characteristic of coronary insufficiency in tracing taken three minutes after thirty 18" ascents in a two-minute period.
Ballistocardiogram taken five minutes after completion of exercise shows accentuated abnormalities.

Figure 14 shows ballistocardiographic and electrocardiographic changes before and after exercise. The tracing is that of an active business executive age 46 who fifteen months earlier had sustained a posterior wall infarct which left no permanent electrocardiographic residua. No electrocardiographic changes nor any pain developed after a standard exercise test but the ballistocardiogram, decidedly abnormal at rest, became abnormal following exercise to such degree that the various waves could no longer be identified. It is seen then that the ballistocardiogram may provide indication of myocardial impairment where the electrocardiogram and exercise test for coronary insufficiency are negative.

Exercise is not ordinarily necessary to elicit abnormality

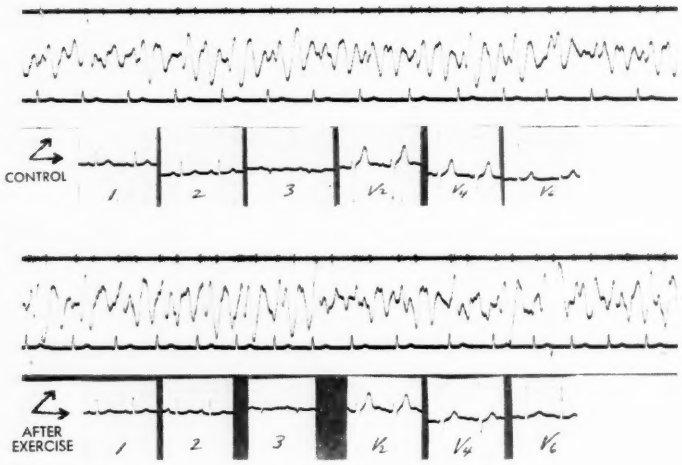

Figure 14.

Ballistocardiographic changes following exercise in male, age 46, with previous posterior wall infarct.

The ballistocardiogram, markedly abnormal at rest became abnormal five minutes after exercise (thirty 18″ ascents in two minutes) to such a degree that no identification of the waves is possible.

The electrocardiogram, normal at rest showed no significant changes in serial tracings after exercise.

in the ballistocardiogram, for so sensitive is the ballistocardiogram that even the slight hemodynamic changes produced by respiration cause marked changes in the various waves as we have already seen. An illustration of how readily changes in the force of the heart beat are produced is seen in Figure 15 which is that of a physician age 40 who, although well and working at the time the record was made, had sustained an attack of acute pulmonary edema four months earlier. The resting ballistocardiogram is relatively normal. With an abrupt rise in blood pressure during immersion of the hand in ice water the ballistocardiogram shows deterioration of the waves to a point where they are scarcely recognizable. Following this 0.3 mg. of the adrenolytic compound C.C.K. ®

® Registered trade mark of Sandoz Pharmaceuticals — Division of Sandoz Chemical Works, Inc.

was given intravenously. This prevented rise of the blood pressure on repeating the cold pressor test, and the ballistocardiogram now showed no significant alteration.

With an instrument of such exquisite sensitivity that it

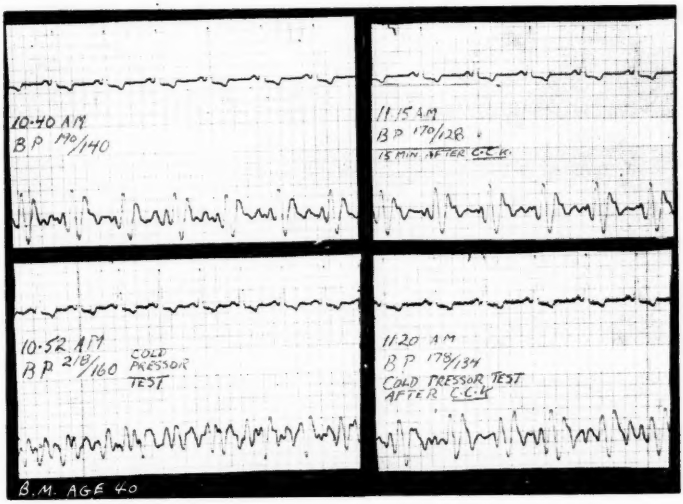

Figure 15.

Abnormalities in ballistocardiogram developing on performance of cold pressor test in subject with hypertensive heart disease. See text for explanation.

reveals abnormality in the majority of subjects in later life, great caution must be observed in applying it to clinical medicine. Does the fact that abnormality occurs so frequently in older individuals indicate that they have some degree of coronary disease and impaired myocardial function? Certainly this is compatible with the other portion of our study which indicates that arteriosclerosis can be demonstrated in a majority of subjects above the age of fifty. Attention may be called to the recent extensive pathological studies of White, Edwards and Dry (14) who demonstrated the presence of a severe grade of coronary artery sclerosis in well over two-thirds of subjects above the age of fifty. Any middle-aged

commuter running for a train will testify that his heart is not what it once was, and this apparently is what the ballistocardiogram reveals. For clinical purposes the ballistocardiogram would appear to be eminently satisfactory as a functional test of the force of the heart. When the tracing is perfectly normal in older individuals we can congratulate them on having a young heart; where it shows moderate variations of the types described we can tell them that they are normal for their age, and when the ballistocardiogram is markedly abnormal and does not show a good configuration even with respiration suspended, there is reason to suspect that all is not well. In this connection one further case may be illustrated (Figure 16). This ballistocardiogram was taken last winter on an executive of advanced years who complained of some atypical chest pain. The electrocardiogram is normal, but the ballistocardiogram shows marked abnormality, the H wave is prominent, I wave is absent, J wave small and

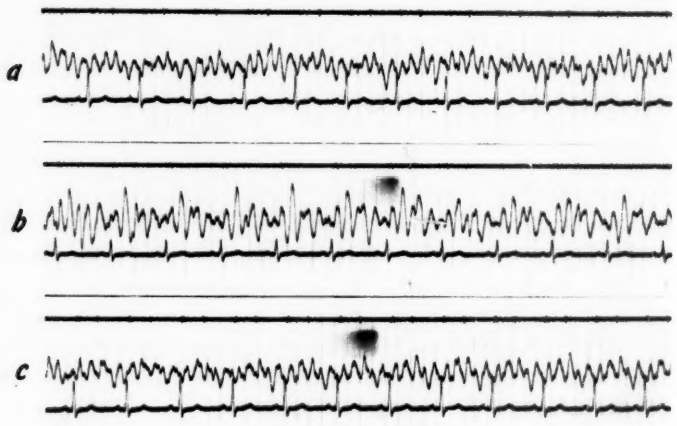

Figure 16.

Ballistocardiogram showing marked abnormalities during normal breathing (a) and with breath suspended in expiration (c). With breath held in inspiration (b) the waves are relatively normal. The subject, age 71, died suddenly of a heart attack ten days after this tracing was made.

slurred and L wave and other after waves large in amplitude. With respiration suspended in the inspiratory phase the tracing becomes relatively normal. With respiration held in expiration, however, abnormalities persist. Ten days after this record was made the subject suddenly expired while giving a speech.

Although the appearance of abnormalities in the ballistocardiogram in older individuals may be indicative of a decreased force of the heart, it appears very probable that such changes as respiratory variations in the wave form and amplitude are determined largely by extracardiac factors. As we have reported elsewhere (12), phasic respiratory variations in vasomotor tone and peripheral resistance may well be responsible for respiratory variation in the ballistocardiogram by altering the arterial capacity. The capacity of the aorta in older subjects is fully double that in younger age groups, and it is to be emphasized that acceleration of the blood column in the aorta contributes to the ballistocardiogram in important measure. Vasomotor responses are greatly accentuated in older individuals, as indicated by such phenomena as exaggerated responses to pressor and depressor blood pressure tests such as the cold pressor test, and the frequency of heightened sensitivity to carotid sinus pressure causing a marked fall in blood pressure and cardiac arrest.

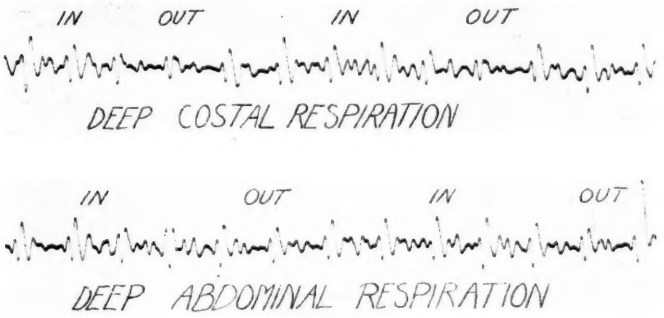

Figure 17.

Ballistocardiograms made on same subject during costal and abdominal respiration. Note that respiratory variation is less marked during abdominal breathing (see text).

The sensory stimulus producing phasic respiratory changes in vasomotor tone arises in the thorax, with afferent fibers transmitted through the upper thoracic nerves (15). It is not surprising therefore that respiratory variation in the ballistocardiogram is much more striking when breathing is of the costal type than of the abdominal diaphragmatic type, as is illustrated in Figure 17. Improvement in the ballistocardiogram such as may be observed on application of an abdominal binder is probably due to increase in the diaphragmatic excursion, and an elevated and more constant vasomotor tone in the splanchnic area.

The increased amplitude of the H wave, which occurs in the initial isometric phase of systole, and which is observed in heart disease as well as in older subjects, is undoubtedly related to a change in cardiac contraction. We have observed by roentgenkymographic studies in the left anterior oblique position that the form of ventricular contraction is different in older individuals and in those with heart disease than in younger healthy individuals. In young subjects the heart becomes spherical in the initial phase of systole, and with shortening of the distance between the apex and aortic root there is a sharp posterolateral outward thrust which is observed in the roentgenkymogram in the early phase of systole. This isometric "kick" does not occur when the heart is enlarged, diseased or feeble. The occurrence of a large H wave therefore may be related to the different form of contraction in early systole when the force of the heart is impaired.

It must be apparent from this discussion that the ballistocardiogram is influenced greatly by technical features of the recording instrument, that the waves are of complex derivation and are affected by extracardiac factors, and that their physiologic significance is not yet well defined. Considerable caution must be observed in interpreting the ballistocardiogram, and further study is necessary before ballistocardiography can assume its place in the clinical armamentarium of cardiac diagnosis.

Predisposition to Arteriosclerosis. Diagnosis is of value primarily to provide a rational basis for therapeutic management. Such

diagnostic signs of arteriosclerosis as calcification of the aorta, electrocardiographic evidence of coronary insufficiency, and ballistocardiographic abnormalities are late developments, at a stage where irreversible atherosclerosis has occurred. Accordingly it is pertinent to focus attention on indications of earlier changes associated with arteriosclerosis.

Several lines of recent investigation point to a disturbance in lipid metabolism as an important predisposing factor in arteriosclerosis. It has long been recognized that there is an increased incidence of arteriosclerosis in clinical conditions accompanied by significant elevation of blood cholesterol. The occurrence of arteriosclerosis in subjects with average levels of cholesterol does not vitiate the importance of this steroid in the genesis of arteriosclerosis, for, as we have pointed out elsewhere (16), the average level of the blood cholesterol is in reality a high cholesterol and of such an order as to predispose to the development of arteriosclerosis. Low levels of blood cholesterol, as we have already mentioned, confer significant protection against the development of arteriosclerosis and this, therefore, may be regarded as beneficial.

The range of the blood cholesterol in the American population is very considerable. Sex differences are not appreciable. The level rises significantly with age (17); at age twenty in normal males the mean value is 173.7; at age forty, 219.4; at age sixty, 253.3. Ninety-eight per cent fall below 248 at age twenty, 316 at age forty, and 343 at age sixty. Body constitution as expressed by the anthropometric somatotype index bears a significant relation to the level of blood cholesterol (18, 19). Higher values are present in the hypersthenic endomorph type than in the asthenic ectomorph type of individual. Several studies point to a strong genetic factor in many subjects with hypercholesterolemia (20–25) and it appears that familial hypercholesterolemia is a very common variant inherited as an incomplete dominant trait.

The level of blood cholesterol is unrelated to dietary intake of cholesterol, fats, or other constituents (26, 27), and cannot

be modified except by drastic dietary restriction of fat (27–30), which accomplishes an increased fecal excretion of cholesterol, since absorption of cholesterol occurs only in the presence of fatty acids (16). Variations in blood cholesterol therefore are due to endogenous rather than dietary factors. The nature of the metabolic factors which determine the levels of cholesterol in particular individuals which are ordinarily quite stable are not known and require clarification. Significant destruction of cholesterol does not occur in the body so that variations are due either to different rates of synthesis, excretion into the gastrointestinal tract, or metabolic factors influencing the amount of cholesterol held in the blood serum.

Cholesterol is synthesized principally in the liver by condensation of numerous small-sized molecules of which acetic acid is the most efficient precursor, contributing most, if not all, of the carbon atoms of cholesterol (31). Alternative metabolic routes may be taken by these two-carbon acetyl fragments (32–34), which are formed in the breakdown of fatty acids, glucose and certain amino acids. The two-carbon acetyl fragment is a focal point in metabolism and the alternative routes it may take, illustrated in Figure 18, may provide a clue to an important variable in cholesterol metabolism. When entry of the acetyl fragment into the Krebs citric acid cycle is impaired, increased substrate is available for other pathways of its reactions, such as the formation of cholesterol. Thus administration of fluoracetate, which blocks entry and utilization of acetyl groups in the Krebs citric acid cycle, augments acetylation in vivo by making available more two-carbon fragments for this reaction (35). The increased pool of two-carbon fragments resulting from excessive fatty acid breakdown in diabetic ketosis may be responsible for increased cholesterol synthesis and the hypercholesterolemia seen clinically in this situation. Our attention is presently being addressed to an exploration of the bearing of the interrelations shown in Figure 18 on cholesterol metabolism, by observing whether cholesterol synthesis is augmented by agents which block the citric acid cycle, and conversely, whether cholesterol synthesis can be decreased by agents which cata-

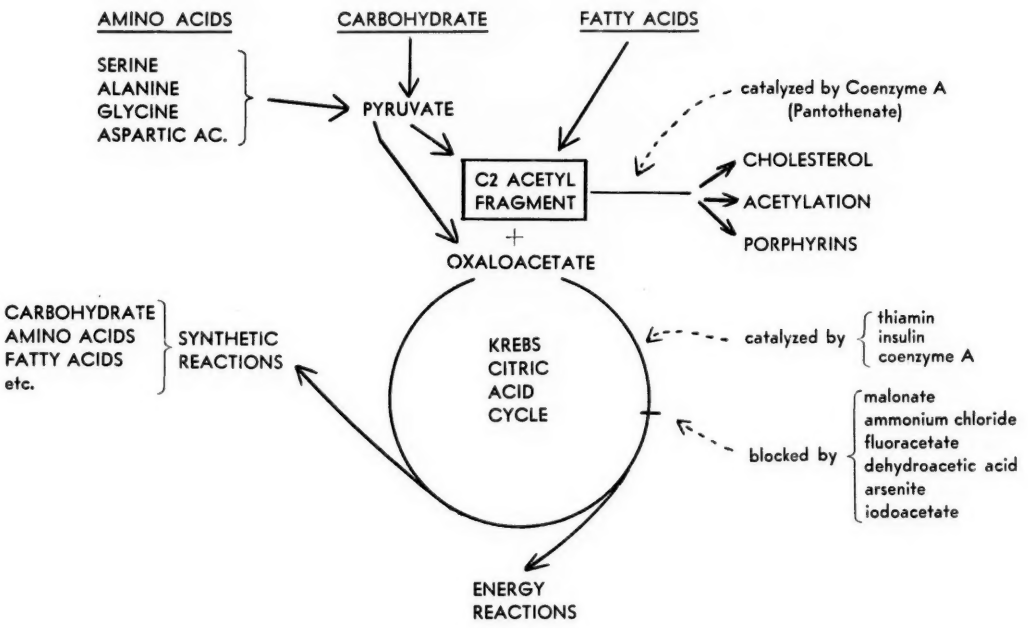

Figure 18.
Schematic representation of metabolic pathways of two-carbon acetyl fragment.

lyze the Krebs citric acid cycle and promote entry of acetyl fragments into this metabolic channel, as for example oxaloacetate.

The disturbance in lipid metabolism in arteriosclerosis does not solely concern the level of blood cholesterol. Cholesterol is an insoluble substance which exists in the serum as a hydrophobic colloid, held in colloidal dispersion by phospholipids (lecithin), and serum proteins which are hydrophilic. Several recent studies indicate that elevation of serum cholesterol *per se* is of less importance in the pathogenesis of arteriosclerosis than an abnormal ratio of cholesterol to phospholipid. In subjects with arteriosclerosis the ratio of cholesterol to phospholipid is significantly increased (36–48). Apart from the absolute ratio of cholesterol to phospholipid, the colloidal state of the phospholipid lecithin may be important. Lecithin, like other hydrophilic colloids, undergoes aging in which process it loses its hydrophilic properties and becomes more hydrophobic (49), thereby becoming less effective in supporting cholesterol in colloidal dispersion. Accordingly, not only the total concentration of lecithin phospholipid, but its renewal by an active turnover rate by the liver (which is promoted by lipotropic agents such as Vitamin B12, choline and inositol) may be important in maintaining the colloidal function of phospholipid. Serum albumin exerts an important adjuvant role on the protective role of lecithin sols, expressed by a high ratio of serum albumin to pseudoglobulin (50). It has been found in studies of experimental arteriosclerosis that the severity and incidence of vascular lesions is less when serum albumin levels are higher, presumably due to stabilization of colloidal dispersion of cholesterol (51). This protective action of albumin is eliminated if globulin is increased.

In recent studies Gofman (52, 53) has observed that the transport of cholesterol and other serum lipids is almost entirely in the form of very large molecular complexes of these lipids with variable amounts of protein. These may be quantitatively studied both as to character and concentration by ultracentrifugal flotation in the analytic ultracentrifuge. The finding by Gofman that a specific species of mole-

cules designated as Sf 10–20 units is increased in subjects with arteriosclerosis and conditions predisposing to arteriosclerosis, may be a physical expression of the aforementioned colloidal changes which comprise an impaired ability of serum to maintain cholesterol in colloidal dispersion; namely, increase in cholesterol, decreased phospholipid and phospholipid to cholesterol ratio, aging of phospholipid with a decreased turnover renewal rate of lecithin, decrease in serum albumin and albumin to globulin ratio.

Although these recent studies clearly indicate that the state of colloidal dispersion of cholesterol is more important than its absolute concentration, the precise role of stabilization of colloidal dispersion of cholesterol in the pathogenesis of arteriosclerosis remains to be defined. We have suggested elsewhere (16) that cholesterol enters the arterial wall by penetration together with protein and phospholipid, and that tissue utilization of hydrophilic colloids such as albumin and lecithin which holds the hydrophobic cholesterol in colloidal dispersion might lead to precipitation of cholesterol in the arterial wall. Such precipitation may be more readily effected when cholesterol is less perfectly dispersed in colloidal sol due to the factors mentioned. Enzymes are present in the aortic wall which can break down phospholipids, such as acid phosphatase (54), which is particularly activated when circulation of nutrient tissue fluid through the arterial wall is impaired resulting in lowered tissue pH. Since the activity of aortic phosphatase is more than quadrupled by a slight decrease in pH from 7.4 to 7.0, it is probable that such a small shift in pH accompanying impairment of circulation of arterial tissue fluid, whose role in arteriosclerosis we have emphasized elsewhere (16), may provide an explanation for the phenomenon of calcification which is so frequently a concomitant of arteriosclerosis.

This brief survey of the lipid disturbance in arteriosclerosis has been presented because it provides a background for the possible clinical application of such procedures as cholesterol to phospholipid ratio, and ultracentrifugal analysis of lipoprotein complexes, as tests of the predisposition to arterio-

sclerosis. Unfortunately these techniques are time-consuming and difficult and do not lend themselves well to large-scale routine performance. It may be that some greatly simplified index of the hydrophilic to hydrophobic colloidal state of the serum may provide a satisfactory index of predisposition to arteriosclerosis, which may be reflected by such changes as a slowed sedimentation rate or increased resistance of erythrocytes to hemolysis. Certainly reinvestigation is warranted of the test introduced some years ago by Loeper (55) of the solubilizing power of serum on cholesterol. Earlier observations that the solubility of cholesterol in the serum varies greatly, with a striking decrease in older individuals beyond the sixth decade, particularly in subjects with arteriosclerosis (56–58), are entirely consonant with more recent developments.

A further disorder in lipid metabolism may be mentioned, which it is claimed may also provide an index of predisposition to arteriosclerosis. Following ingestion of fat, macromolecular particles composed of neutral fats and cholesterol, called chylomicrons, appear in increased amounts in the serum and may be quantitatively counted. It has been reported that in older individuals, in diabetic subjects, and in those with arteriosclerosis, the chylomicron count following a standard fat meal is higher and considerably more sustained than in normal subjects (59–63).

It is apparent that recent investigations have opened several promising channels which may provide clues to the pathogenesis of arteriosclerosis and practical procedures for the recognition of a predisposition to this disorder. It is here that the core of the problem lies, rather than in refinement of present diagnostic techniques which are in effect not harbingers but actual heralds of decay.

(The author gratefully acknowledges the technical assistance of Mr. George Green and Mrs. Dorothy Brown of the Diagnostic and Chemical Laboratories of the Equitable Life Assurance Society of the United States.)

BIBLIOGRAPHY

1. Kendall, F. E., Abell, L. L., Levy, B. B., Steele, J. M. and Brodie, B. B.: Fed. Proc. **8**:212, 1949.
2. Sheridan, J. T.: Trans. Assoc. Life Ins. Med. Dir., Amer. **28**:49, 1941.
3. Ungerleider, H. E., Gubner, R. and Rodstein, M.: Proc. 22nd Scient. Sessions, Am. Heart Assn., June, 1949.
4. Gubner, R. and Ungerleider, H. E.: N. Y. State J. Med. **48**:2491, 1948.
5. Starr, I.: Harvey Lectures, **42**:194, 1947.
6. Hamilton, W. B., Dow, P. and Remington, J. W.: Am. J. Physiol. **144**:557, 1945.
7. Nickerson, J. L. and Curtis, H. J.: Am. J. Physiol. **142**:1, 1944.
8. Dock, W. and Taubman, F.: Am. J. Med. **7**:751, 1949.
9. Scarborough, W. R., Beser, J., Talbot, S. A., Mason, R. E., Singewald, M. D. and Baker, B. M., Jr.: Bull. Johns Hopkins Hosp. **87**:235, 1950.
10. Braunstein, J. R., Oelker, C. E. and Gowdy, R. G.: J. Clin. Inv. **29**:1219, 1950.
11. Sheehan, G. A., Jr., Priebe, F. K., Dranetz, A. I. and Howatt, G. N.: Bull. N. Y. Acad. Med. **26**:262, 1950.
12. Gubner, R., Rodstein, M. and Ungerleider, H. E.: Proc. 23rd Scient. Sessions, Am. Heart Assn., June 24, 1950.
13. Dock, W.: Personal communication.
14. White, N. K., Edwards, J. E. and Dry, T. J.: Circ. **1**:645, 1950.
15. Gilliatt, R. W., Guttmann, L. and Whitteridge, D.: J. Physiol. **107**:67, 1948.
16. Gubner, R. and Ungerleider, H. E.: Am. J. Med. **6**:60, 1949.
17. Keys, A., Mickelsen, O., Miller, E. v. O., Hayes, E. R. and Todd, R. L.: J. Clin. Inv. **29**:1347, 1950.
18. Kornerup, V.: Arch. Int. Med. **85**:398, 1950.
19. Gertler, M., Garn, S. M. and Sprague, H. B.: Circ. **2**:380, 1950.
20. Boas, E. P. and Adlersberg, D.: J. Mt. Sinai Hosp. **12**:84, 1945.
21. Boas, E. P., Parets, A. D. and Adlersberg, D.: Am. Heart J. **35**:611, 1948.
22. Adlersberg, D., Parets, A. D. and Boas, E. P.: J. A. M. A. **141**:246, 1949.
23. Wilkinson, C. F., Jr., Hand, E. A. and Fligelman, M. T.: Ann. Int. Med. **29**:671, 1948.
24. Wilkinson, C. F., Jr.: Bull. N. Y. Acad. Med. **26**:670, 1950.
25. Alvord, R. M.: Arch. Int. Med. **84**:1002, 1949.
26. Wilkinson, C. F., Jr., Blecher, E. and Reimer, A.: Arch. Int. Med. **85**:389, 1950.
27. Keys, A., Mickelsen, O., Miller, E. v. O. and Chapman, C. B.: Science **112**:79, 1950.
28. Kempner, W.: Bull. N. Y. Acad. Med. **22**:358, 1946.
29. Watkin, D. M., Froeb, H. F., Hatch, F. T. and Gutman, A. B.: Am. J. Med. **9**:428, 1950.
30. Mellinkoff, S. M., Machella, T. E. and Reinhold, J. G.: Am. J. Med. Sci. **220**:203, 1950.

31. Bloch, K.: Circ. **1**:214, 1950.
32. Potter, V. R. and Heidelberger, C.: Physiol. Rev. **30**:487, 1950.
33. Elliott, W. B. and Kalnitsky, G.: J. Biol. Chem. **186**:477, 1950.
34. Brady, R. O. and Gurin, S.: J. Biol. Chem. **186**:461, 1950.
35. Chenoweth, M. B.: J. Pharm. and Exp. Ther. **97**:383, 1949.
36. Ahrens, E. H., Jr. and Kunkel, H. G.: J. Exp. Med. **90**:409, 1949.
37. Ahrens, E. H., Jr. and Kunkel, H. G.: J. Clin. Inv. **28**:1565, 1949.
38. Ahrens, E. H., Jr.: Bull. N. Y. Acad. Med. **26**:151, 1950.
39. Kellner, A., Correll, J. W. and Ladd, A. T.: Fed. Proc. **8**:259, 1949.
40. Ladd, A. T., Kellner, A. and Correll, J. W.: Fed. Proc. **8**:360, 1949.
41. Kellner, A., Correll, J. W. and Ladd, A. T.: Am. Heart J. **38**:460, 1949.
42. Davidson, J. D., Abell, L. L. and Kendall, F. E.: Am. Heart J. **38**:462, 1949.
43. Gertler, M. M. and Garn, S. M.: Science **112**:14, 1950.
44. Gertler, M. M., Garn, S. M. and Lerman, J.: Circ. **2**:205, 1950.
45. Gertler, M. M., Garn, S. M. and Sprague, H. B.: Circ. **2**:380, 1950.
46. Gertler, M. M., Garn, S. M. and Bland, E. E.: Circ. **2**:517, 1950.
47. Morrison, L. M., Gonzalez, P. and Wolfson, E.: Circ. **2**:472, 1950.
48. Jackson, R. S., Wilkinson, C. F., Jr., Hand, E. A., Waldron, A. M. and Vogel, W. E.: Circ. **2**:472, 1950.
49. Freundlich, H.: Kapillarchemie, Leipzig, 1922.
50. Spiegel-Adolf, M.: "Physical Chemistry of Lipides" in COLLOID CHEMISTRY, ed. by J. Alexander Reinhold Publ. Co., N. Y., Vol. V, p. 1119, 1944.
51 Pollak, O J.: Circ. **2**:464, 1950.
52. Gofman, J. W.: Science **111**:166, 1950.
53. Gofman, J. W., Jones, H. B., Lindgren, F. T., Lyon, T. P., Elliott, H. A. and Strisower, B.: Circ. **2**:161, 1950.
54. Kirk, E. and Praetorius, E.: Science **111**:334, 1950.
55. Loeper, M., Lemaire, A. and Lesure, A.: Compt. rend. Soc. de Biol. **98**:101, 1928.
56. Schonholzer, G.: Helvet. med. Acta **6**:692, 1939.
57. Eck, M. and Desbordes, J.: Compt. rend. Soc. de Biol. **117**:428, 1934.
58. Eck, M. and Desbordes, J.: Ibid. **118**:498, 1935.
59. Moreton, J. R.: Science **106**:190, 1947.
60. Moreton, J. R.: Science **107**:371, 1948.
61. Moreton, J. R.: J. Lab. and Clin. Med. **35**:373, 1950.
62. Becker, G. H., Meyer, J. and Necheles, H.: Science **110**:529, 1949.
63. Zinn, W. J. and Griffith, G. C.: Am. J. Med. **8**:525, 1950.

PRESIDENT UNGERLEIDER — This paper is now open for discussion.

DR. ROBERT A. GOODELL — I want to say that I was very much interested in this paper and certainly the ballistocardiogram means a lot more to me than it did. I still have a lot

more to learn. In your reference to elevated blood pressures in the first part of your paper would you indicate a little more closely the ranges of blood pressure you were considering?

DR. GUBNER — These subjects with elevated blood pressure all had a moderate or slight degree of hypertension. In other words, if the blood pressure was beyond insurable limits, they were not called into the home office for examination. We included in this category those whose resting blood pressure was over 140 systolic, and above 90 diastolic in all records. But very few of them exceeded systolic of 160 to an occasional reading of 170, and in no case was the diastolic over 104 to 106.

In other words, as Dr. Dock pointed out previously, an objective in the therapy for hypertension should not be confined to immediate relief of symptoms, but looking at it from a long range point of view, even slight degrees of hypertension, as in this small series of cases, evidently accentuate the development of arteriosclerosis.

PRESIDENT UNGERLEIDER — Dr. Roy W. Scott received his Bachelor of Arts degree at Indiana University, his Master's degree and Doctor of Medicine at the Western Reserve University at Cleveland and then pursued graduate studies at the University of Vienna. His entire medical career has been in Cleveland at the Western Reserve University where he has occupied practically all the positions in the Department of Medicine and since 1929 he has been Professor of Medicine. He is a member of the American Board of Internal Medicine, the American College of Physicians, the Association of American Physicians and many other societies. He has been President of the American Heart Association and among many other things, he is particularly noted for his investigations in the field of cardiovascular diseases. Dr. Scott will now address us on "Prognosis in Coronary Artery Disease".

PROGNOSIS IN CORONARY ARTERY DISEASE*

R. W. Scott, M. D.

Professor of Medicine

Western Reserve University, Cleveland, Ohio

There is no aspect of the subject, coronary artery disease, more difficult or fraught with more uncertainty than that of prognosis. The validity of this statement is perhaps more apparent to those in life insurance medicine than to the practicing physician, as they deal annually with thousands of cases of coronary disease, many of whom in the prime of life have died suddenly and unexpectedly with no previous symptoms of coronary insufficiency. Often a man is accepted in the forties as a standard risk for a sizeable policy only to drop dead of coronary occlusion after paying a few years' premiums. On the other hand, there are individuals with clear-cut symptoms of coronary insufficiency and the anginal syndrome who, with care, may survive a goodly number of years. Furthermore, it is not uncommon to find at post mortem, widespread coronary arteriosclerosis that was clinically silent. To explain these apparent vagaries, we must examine some of the more recent work dealing with the anatomy, pathology and physiology of the coronary bed. Although this work does not solve all the problems, it does throw considerable light on the question, "Why is the prognosis in coronary disease so difficult to determine"?

The Anatomic Pattern of the Coronary Arteries

Observations on the blood supply to the heart based on careful anatomic dissection date from the middle of the 16th century. Since that time several methods have been devised to visualize not only the larger arteries, but also the smaller

*From the Department of Medicine, Western Reserve University and Cleveland City Hospital.

ramifications of the coronary bed. In 1921 Gross (1) published a method of visualizing the coronary bed by injecting barium sulphate and gelatin and then taking stereoscopic roentgenograms of the injected specimen. Although yielding more information than any previous techniques, Gross' method was open to criticism because his roentgenograms had to be interpreted stereoscopically, and since the blood vessels from the various planes of the heart overlap, the interpretation of such films is very difficult. To overcome the major objections to Gross' method, Schlesinger (2) in 1938 devised a unique method of dissecting the heart, so that the injected coronary circulation could be visualized in one plane. We (3) have recently modified his method of dissection so as to preserve the architecture of the aortic and pulmonary valves and sub-

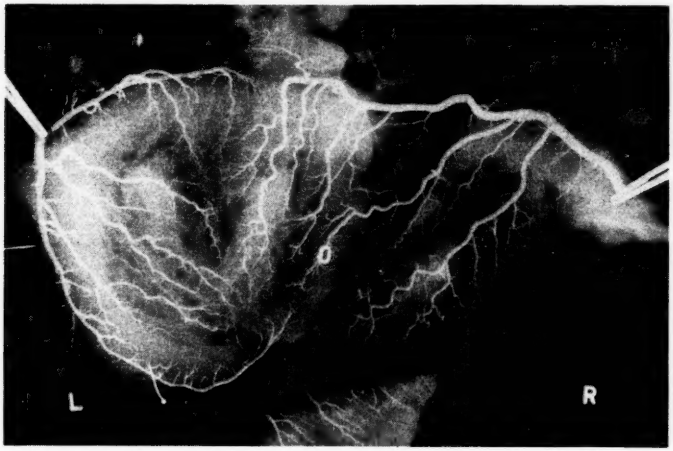

Figure 1.

The coronary bed in the heart of a 72 year old male showing no coronary disease and no intercoronary anastomosis.

In this and all other illustrations the heart was opened by the Schlesinger method so it lies on one plane and the coronary bed was visualized by the injection of a suspension of barium sulphate in an aqueous ammoniated solution of liquid latex. The inter-ventricular septum is removed and its site is marked by the letter "O" so that the right ventricle lies to the right and the left ventricle to the left of the letter O. Note in this heart that the right coronary artery supplies all the right ventricle, the septum and a considerable part of the left ventricle, hence it is an example of right coronary artery preponderant.

stituted for his lead phosphate agar, a suspension of barium sulphate in an aqueous ammoniated solution of liquid latex, first employed by Salans and Tweed (4).

In the routine study of human hearts by the Schlesinger technique, it now becomes apparent that the anatomic pattern of the coronary arteries varies widely and is not identical in any two hearts. However, the distribution of the two main coronary arteries is such that one may divide human hearts into three patterns: 1) in which the right coronary artery supplies all the right ventricle, a part of the septum and part of the left ventricle; such a heart we may call a right coronary artery preponderant, as illustrated in Fig. 1; 2) in which the right coronary artery supplies only the right ventricle and posterior part of the septum and the left coronary artery supplies the left ventricle and the anterior part of the septum; such a heart we may designate as one with a balanced circulation, as illustrated in Fig. 2; 3) in which the left coronary

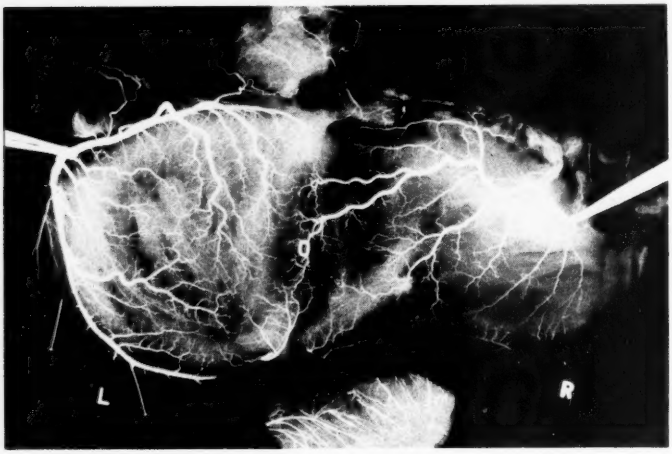

Figure 2.
The coronary bed in a 42 year old male showing a balanced circulation and normal coronary arteries.

artery supplies all the left ventricle, all the septum and a part of the right ventricle; such a heart we may designate as left coronary artery preponderant, as illustrated in Fig. 3.

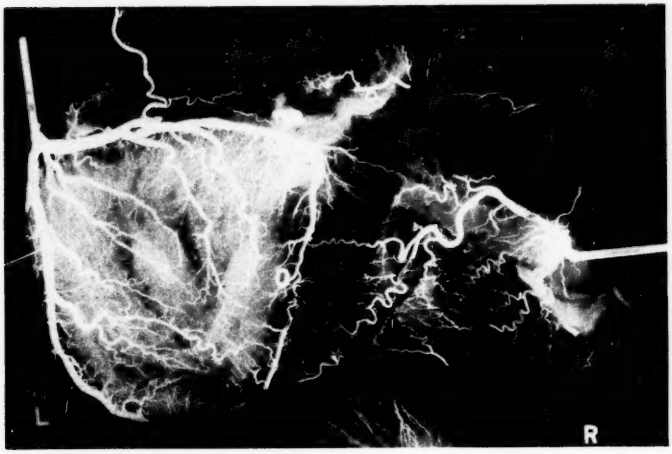

Figure 3.

An example of left coronary artery preponderant in which the left coronary artery supplies the left ventricle, the septum and part of the right ventricle. In addition, this heart illustrates the effect of chronic anemia, the development of intercoronary anastomosis, particularly marked in the left ventricle. The coronary arteries show no evidence of sclerosis.

Schlesinger has found, and in a smaller series of cases we have been able to confirm, that the clinical course of a patient with coronary arteriosclerosis is definitely affected by the congenital pattern of his coronary circulation. For example, hearts with left arterial preponderance are the most vulnerable to coronary disease, showing the highest incidence of coronary occlusion with myocardial infarction usually resulting in death. The pattern of the coronary tree is such that little collateral circulation from the right coronary artery is possible. The heart best equipped to adjust itself to coronary disease is the one with a balanced circulation where the collateral anastomosis between the terminal arterioles of the two main vessels is easily established. In this group are the majority of hearts

that survive one or more infarctions. Somewhat intermediate in vulnerability to coronary disease is the heart with a right coronary preponderance. About 50 per cent of human hearts, both male and female, show the right coronary artery preponderance when the arterial bed is visualized at post mortem. In hearts showing a balanced circulation, the type best equipped to adjust to coronary disease, women predominate, whereas, the anatomic pattern most vulnerable to coronary disease, namely, left preponderant, is found more often in men than in women. Thus we see that in the presence of coronary disease the capacity of a given heart to carry on is greatly influenced by its coronary pattern, and until it is possible to determine this pattern in the living patient one important factor in prognosis must remain an unknown.

Although the anatomic pattern of the coronary circulation plays an important role in the development of intercoronary collateral anastomosis, there are other factors to be considered. The question as to whether or not the coronary arteries were end arteries was debated among anatomists and physiologists for many years but the concensus of opinion now is that anastomotic circulation does exist within the heart. However the functional significance and circumstances which affect the development of such a circulation are not entirely settled.

Gross, Spalteholz (5) and others believe as a result of their studies, that an anastomotic circulation developed between pre-capillary vessels as a result of age. This conclusion was not verified by Blumgart and his associates who found no significant anastomotic connection between the right and left coronary arteries in even senile patients who had little or no coronary arteriosclerosis. These observations we have confirmed (see Fig. 1). They concluded that the adequate stimulus for the development of intercoronary anastomosis was arteriosclerotic narrowing or occlusion of the coronary arteries. As this process leads to myocardial ischemia, the thought occurred to us that perhaps ischemia alone without coronary disease might be the important factor in the development of pre-capillary coronary anastomosis. Observations on two cases confirmed this suspicion.

Case 1. A female aged 52 was admitted to the hospital moribund and died within four hours. Red blood cells numbered 7,000,000 and the blood smear had the typical appearance of pernicious anemia. The post mortem findings supported the diagnosis. Visualization of the coronary bed revealed very extensive intercoronary anastomosis with no evidence of coronary disease (see Fig. 3).

Case 2. A female aged 52 had a history of aplastic anemia of several years duration. The red blood cells varied between 1.5 and 2.5 million over the three year period that the patient was under observation. Visualization of the coronary bed revealed, as in Case 1, extensive intercoronary anastomosis and no coronary arteriosclerosis (see Fig. 4).

The findings in these two cases of profound anemia are interesting in the light of the clinical observations of Amadeo (6) published in 1944. As a practitioner in a rural district of Puerto Rico, he became impressed with the fact that his patients over 45 with chronic anemia due to uncinariatic in-

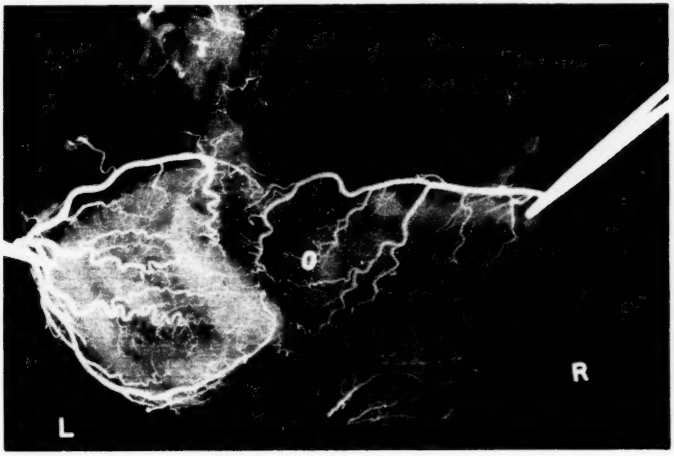

Figure 4.
Note the absence of coronary disease and the rich intercoronary anastomosis particularly in the left ventricle.

festation and inadequate diets rarely had angina or coronary occlusion and in spite of their anemia were able to do strenuous physical exercise with extreme ease. He postulated solely on the basis of his clinical experience that the existence of a moderately severe but tolerable anemia for a sufficient length of time is capable of exerting a beneficial effect on the normal human heart. If chronic myocardial ischemia is a factor in developing intercoronary anastomosis as it appeared to be in our two cases, it may well explain Amadeo's observations.

In this connection, it would be interesting to know the incidence of myocardial infarction in people with chronic anemia and also in individuals living at high altitudes such as Peru. Another factor which influences the development of intercoronary anastomosis, and hence prognosis, is the rate at which coronary narrowing occurs. Proceeding slowly, the heart is given ample time to open collateral channels and compensate for the resulting ischemia. So extensive may be the collateral circulation in some hearts, usually in the older age groups, that in spite of widespread coronary arteriosclerosis, the patient during life had no symptoms of coronary insufficiency, and indeed may have sustained occlusion of a major vessel without infarction of the myocardium. Such a case is illustrated in Fig. 5. I have a 79 year old male patient whom I have examined at least annually for the past ten years. Judged by his capacity to exercise without anginal symptoms, and by the fact that he exhibits less S-T depression in the electrocardiogram with a given amount of effort with the two-step test of Master, he now has a more adequate coronary circulation than he had ten years ago. Very likely he was fortunate enough to have been born with a balanced circulation and the sclerotic process in his coronary bed had advanced at a slow rate. From our observations and those of Blumgart and Schlesinger, it appears that the rate at which collateral circulation can develop is slow. Sudden occlusion of a main coronary artery from thrombosis with relatively little generalized coronary arteriosclerosis is often fatal and a massive infarction is found at post mortem.

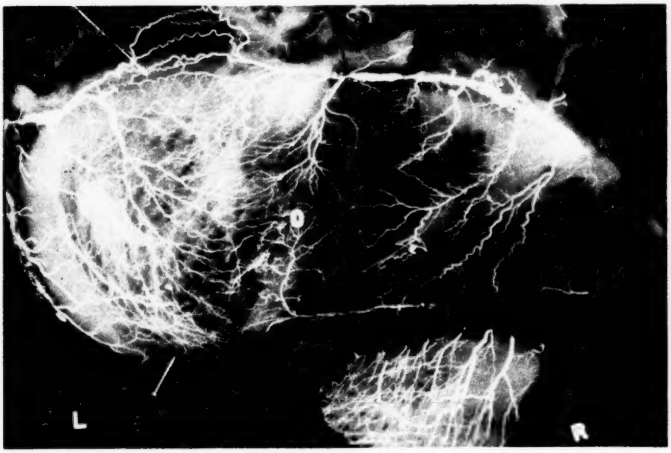

Figure 5.
The heart of an 88 year old female with no symptoms of coronary disease during life yet both the right and left coronary arteries were the seat of old occlusions. Note the rich intercoronary anastomosis.

Handicapped as we are in predicting whether or not any given individual will develop coronary artery disease, it should be emphasized that with the knowledge accumulated from clinical and pathological observations over the past 30 years, we may now estimate more accurately than formerly, the incidence of coronary artery disease as it may occur in a large group of people. This obviously is important from an actuarial standpoint. For example, it is well established that persons with arterial hypertension exhibit a significantly higher incidence of coronary arteriosclerosis than do people with normal blood pressure. The incidence of coronary disease in normotensive non-diabetic women under 50 is notoriously low as compared to men of the same age.

As I have indicated above, the most important feature relating to prognosis cannot be determined in the living patient. Nevertheless, it cannot be said that no progress whatever has been made in predicting at least in individual cases which will do well and which will not, particularly

patients with coronary occlusion and myocardial infarction. Here we may consider the immediate prognosis and the remote or ultimate outcome.

Immediate Prognosis

Early studies placed the immediate mortality of coronary occlusion as high as 50 per cent. More recent observations have shown it to be much lower and, depending to some extent on the economic status of the patient, the figures vary between 20 and 30 per cent. Andrus found that in a series of 888 cases of coronary occlusion at the Johns Hopkins Hospital the mortality rate among private patients was 18 per cent as compared to nearly 30 per cent among ward patients who received the same treatment. He thinks that earlier diagnosis and hospitalization account for the difference. Of great prognostic import is the persistence over several hours of peripheral circulatory collapse with cyanosis, sweating and systolic blood pressure under 80 mm of mercury. The mortality in such cases is upwards of 90 per cent. As fever and leucocytosis vary with the amount of myocardial necrosis, it is not surprising that Levine found that the mortality was 71 per cent in patients with temperatures above 103 F. as compared to 29 per cent in those with fever below 103 F. Where the white blood count was under 15,000, the mortality rate was 16 per cent and over 15,000 it was 54 per cent. Dyspnea and the presence of left heart failure with râles at the lung bases raise the mortality above 50 per cent. A persistent tachycardia (120 or above) and the appearance of ventricular tachycardia are grave prognostic signs. Complications such as pulmonary infarction and peripheral vascular occlusions affect the prognosis adversely. Even in patients who develop none of the above signs known to raise the mortality in coronary occlusion, there is no sure method of predicting their outcome, certainly for the first two weeks. Following this period and provided no complications have appeared, one can then with increasing confidence predict their recovery.

Ultimate Prognosis

From the published data it appears that between 65 and 70 per cent of patients outlive their first attack of coronary

occlusion, that about 25 per cent survive more than 10 years, and about 50 per cent for five years or longer. The average survival time in 101 cases followed by Levine was 41.1 months. All observers agree that the most important single factor influencing the ultimate prognosis is the age of the patient at the time of the initial attack. Younger patients live longer and their recovery is more complete. Finally, it should be emphasized that the ultimate outcome in a patient with coronary occlusion is influenced by the care given immediately following the acute episode. Such work as has been done indicates that an important element in the development of collateral channels in the coronary bed is the element of time, and the process is a slow one. This has been emphasized recently by Blumgart and his associates as a result of animal experiments and affords, I believe, sound reason for reducing the patient's physical and emotional outlay for many weeks following an attack of coronary occlusion with myocardial infarction. Early ambulation of such cases, as has been recommended in some quarters recently, certainly cannot be justified.

In summary, I may say that as a result of post mortem studies of the coronary circulation we now have some insight bearing on the question raised in the first part of this paper, namely, "Why is prognosis so uncertain in coronary artery disease?" One factor, perhaps the most important in determining the heart's capacity to develop collateral anastomotic circulation of functional significance, is the anatomic pattern of the coronary bed. This may be an hereditary characteristic and if so it will explain the well-known familial incidence of death from coronary disease. Until we have a method of visualizing adequately the coronary circulation during life, the factor of the anatomic pattern and the degree of coronary arteriosclerosis existing in any given heart, will remain as unknowns in the equation and will continue to make prognosis uncertain.

BIBLIOGRAPHY

(1) Gross, L.: The Blood Supply of the Heart, New York, 1921, Paul B. Hoeber.
(2) Schlesinger, M. J.: Am. Heart J. 15: 528, 1938.
(3) Scott, R. W., Young, A. F., Zimmerman, A. A., Kroh, I.: Am. Heart J. 38: 881, 1949.
(4) Salans, A. H., Tweed, P.: Am. Heart J. 33: 477, 1947.
(5) Spalteholz, W.: Die Arterien der Herzwand, Leipzig, 1924, S. H. Heizel.
(6) Amadeo, J. A.: Am. Heart J. 28: 699, 1944.

PRESIDENT UNGERLEIDER — Thank you, Dr. Scott. Dr. Scott's paper is now open for discussion. Are there any questions?

DR. GORDON P. BARNETT — I should like to ask Dr. Scott what his advice is to a patient who has survived five years after coronary occlusion, as far as moderate exercise and things of that sort are concerned.

DR. ALEXANDER E. VENABLES — I should like to ask Dr. Scott about the use of dicumarol, and the continued use of dicumarol in prognosis of coronary artery disease.

DR. SCOTT — The first question was about advice to a patient with five years' survival from coronary occlusion with myocardial infarction. The more patients I follow, the more impressed I am with the importance of the nervous system in determining how well and how long a man gets along. I am just as concerned about emotional and nervous bombardment, perhaps more so, as I am about whether the patient should climb one flight of stairs or stop halfway up. I have seen many patients whose first intimation of any coronary difficulty occurred under circumstances of emotional excitement, and effort was not in the picture, and certainly clinical experience is opposed to the views of some physiologists that the coronary bed is entirely devoid of any nervous control.

So, in advising patients who have recovered from coronary occlusion of three, four, and five months previously, I try to impress them with the importance of avoiding, as much as possible, situations that may prove to be emotionally upsetting. It is very much easier for a man to control his physical outlay than it is his emotional outlay.

Now, as to the question of using dicumarol in a prolonged course of treatment following coronary occlusion, I would not advise it. I think the evidence is sound that in the acute process it is worthwhile. As to the use of dicumarol routinely — in those who are subject to embolic occlusions, particularly in patients with rheumatic heart disease with a history of one or more vascular occlusions, I think it is advisable, but only with adequate laboratory control. I think everybody will agree that dicumarol is a dangerous drug without laboratory control, and I certainly would never give it to a patient unless I were sure of the findings in the laboratory.

DR. GEORGE MCLEAN — May I ask Dr. Scott whether he would care to discuss the emotional factors in coronary disease?

DR. SCOTT — In individual cases, it is often very difficult, and I know what you gentlemen must face from a few experiences that I have had regarding the role of emotion in producing symptoms. Very often, after a patient has recovered from a coronary occlusion, it is extremely difficult for the doctor to know how many of their complaints are in the head and how many in the heart. I have seen patients very much more crippled by the psychic trauma incident to mismanagement during the acute attack.

Now, I will give you a personal experience I had some time ago. A chief medical man of an insurance company referred to me a patient who had a disability contract in his life insurance policy. At 51, he had a coronary occlusion. The evidence was indisputable. Very well, he was put on the payroll. Now, this man was unfortunate enough to have been in the hands of what one may call a crepe-hanging doctor, who impressed him with how fortunate he was to have survived the attack and how crippled he would be if and when he recovered.

The patient convalesced in Florida for some eight or ten months and returned to Cleveland but did not appear at his office. He had been on the insurance payroll for 14 months at the time I saw him. After examining the patient I felt that he had made a good recovery. His electrocardiogram had re-

turned to normal, and if I had not seen the original curves I could not have made a diagnosis of infarction. I wrote the chief medical examiner that in my opinion, this was not a problem of coronary disease, but a psychiatric problem. Here was a man seriously crippled emotionally from what I regarded as poor medical management at the time of the initial attack.

That the nervous system plays some role in determining the caliber of the coronary bed seems entirely reasonable. The exact role of a fright, such as an automobile accident, in inducing coronary occlusion is fraught with so much speculation and lack of evidence that I do not believe anyone can answer that question.

PRESIDENT UNGERLEIDER — The next paper concerns the subject of myocardial infarction. In their paper, Drs. Frederick A. Waldron and W. Pepper Constable give the experience of their company in connection with disability claims contracts based on this impairment. Dr. Waldron, Assistant Medical Director, The Mutual Life Insurance Company of New York, will present their paper at this time.

MYOCARDIAL INFARCTION — A MORTALITY STUDY * †

FREDERICK A. WALDRON, M. D.
Assistant Medical Director
and
W. PEPPER CONSTABLE, M. D.
Home Office Medical Examiner
The Mutual Life Insurance Company of New York
New York City

In the period of years since myocardial infarction was first recognized as a clinical entity, there has been a continuing interest in its immediate and long term prognosis. It has been properly recognized as a very serious impairment and one usually expected to shorten the life span. In the past, most life insurance companies have been reluctant to insure any applicant with a history of myocardial infarction, no matter how remote.

This is a study of 1551 cases of myocardial infarction. Our purpose has been to evaluate the life insurance hazards of this impairment. It must be emphasized that this investigation considers not the immediate mortality but only the survivors of the acute attack. The basis is an analysis of disability claims and these contracts stipulate a minimum waiting period of three months. Therefore, the nature of the material studied automatically excluded the early deaths and we are concerned here only with those surviving three months or longer. It should be acknowledged here that we owe to Mr.

* We wish to acknowledge the assistance of Mr. Neil W. Macintyre who made many helpful suggestions in addition to calculating the mortality tables.

†We are indebted to Dr. Henry A. Bancel for much valuable advice in planning and carrying out this investigation.

Pearce Shepherd of the Prudential Insurance Company the concept of using disability claims as a source of material for mortality studies.

Material and Method

The material was drawn from our disability claims files. All cases with a diagnosis of coronary thrombosis, coronary occlusion, or myocardial infarction existing on January 1, 1934, and all new claims paid from that date until December 31, 1949, were reviewed. These totalled 2562 cases. Early in the study, it became apparent that the diagnosis of myocardial infarction could be seriously questioned in a number of instances. The doubtful cases appeared to be angina without evidence of infarction, pulmonary infarction, arteriosclerotic or hypertensive heart disease, or disease other than proven myocardial infarction. These were eliminated leaving a total of 1551 authentic cases for our study.

The usual criteria for the diagnosis of myocardial infarction were observed in this screening process. However, it should be stated that the selection of cases rested chiefly on a diagnostic electrocardiogram. Where no electrocardiogram was available for review or where it was not diagnostic, the case was not included unless the clinical history and course, physical findings, and other laboratory data were considered adequate proof that myocardial infarction had occurred. Undoubtedly a number of authentic cases were eliminated by possibly overrigid requirements but this was considered wiser than diluting the material with dubious cases.

No distinction was made between "cash payment" and "waiver of premium" claims. We feel that rejection of cases in which the diagnosis was uncertain has eliminated questionable claims and cases of malingering thereby removing any need for such a distinction.

The following data were recorded for each case: Age at onset, survival time, associated or preexisting defects or disease, complications, electrocardiographic pattern, and cause of death.

TABLE 1

AGE DISTRIBUTION AT ONSET OF SERIES

AGE AT ONSET	MUTUAL LIFE SERIES	LITERATURE SUMMARY BY DOSCHER & POINDEXTER
30 – 39	51	155
40 – 49	476	581
50 – 60	1024	992
TOTAL	1551	1728

The disability contracts terminated at age 60, so no case in this series had its onset after that age. Since mortality rates may be greatly affected by varying distribution of the different age groups, it is important to know if the age groups in our selected series are comparable to an unselected group. Table 1 shows the breakdown by age groups compared to the totals reported by Doscher and Poindexter (1) as summarized from the literature. It is seen that the two series correspond fairly closely, indicating that our group is representative of the general experience in regard to age at onset.

Our series is composed almost entirely of males, less than one per cent being females. Although sex is thought to be a significant factor in the mortality from myocardial infarction, the percentage of females in this study is so small as to be almost negligible. Therefore no separate study by sex was made.

Results

I. *Overall Mortality of Entire Group.*

In order to get a basis for comparison of the various subdivisions, the overall mortality was first calculated by age at the time of the attack and by survival time from the date of onset. These results are shown in Table 2 which includes the mortality rates per thousand, the actual number of deaths in each category, and, in addition, the mortality ratio as calculated from the 1941 Commissioners Standard Ordinary

TABLE 2

OVERALL MORTALITY BY ACTUAL LIVES

DURATION FROM ATTACK IN YEARS	AGE AT ATTACK 30–39			40–49			50–60			ALL AGES		
	DEATH RATE PER M/YR.	ACTUAL DEAD	* MORT. RATIO	DEATH RATE PER M/YR.	ACTUAL DEAD	* MORT. RATIO	DEATH RATE PER M/YR.	ACTUAL DEAD	* MORT. RATIO	DEATH RATE PER M/YR.	ACTUAL DEAD	* MORT. RATIO
1	82	4	1600	85	36	950	107	102	600	99	142	650
2	111	5	2050	74	29	750	100	83	500	93	117	600
3-5	79	9	1300	73	70	650	84	144	350	80	223	450
6-10	69	7	850	92	84	600	98	128	350	94	219	400
11+	60	2	550	84	29	350	131	39	300	104	70	350
TOTAL	79	27	1150	82	248	600	97	496	400	91	771	400

* MORTALITY RATIO CALCULATED FROM 1941 COMMISSIONERS STANDARD ORDINARY TABLE

table. Study of this table shows that the mortality ratio decreases with duration of survival time although the actual mortality in deaths per thousand may actually increase. This is explained by the fact that mortality rates normally increase with age. Of particular interest are the higher mortality ratios in the younger age group.

Most authorities (2, 3, 4) have pointed out that the mortality rate of survivors from myocardial infarction is higher in the

TABLE 3

EXCESS OF ACTUAL DEATHS OVER EXPECTED DEATHS
PER M OF EXPOSURE YEAR •

DURATION FROM ONSET	AGE AT ONSET 30 - 39	40 - 49	50 - 59	ALL AGES
1ST YR.	77	76	89	85
2ND YR.	106	64	81	77
3RD - 5TH YR	73	62	61	62
6TH - 10TH YR.	61	77	68	71
11TH+ YR.	49	61	87	72
TOTAL	72	68	73	71

• EXPECTED DEATHS COMPUTED BY 1941 C.S.O. TABLE

TABLE 4

AVERAGE LIFE EXPECTANCY AFTER MYOCARDIAL INFARCTION
1551 CASES

AGE AT ONSET	APPROX. LIFE EXPECTANCY MUTUAL LIFE SERIES	NORMAL LIFE EXPECTANCY BY C.S.O. TABLE
30 – 39	11.5 YEARS	33.4 YEARS
40 – 49	10.5 YEARS	25.2 YEARS
50 – 60	8.5 YEARS	17.8 YEARS

WALDRON Mutual Life 1950

older age groups. However this analysis, as indicated in Table 3, shows very little difference in the mortality rate for the different age groups over a period of years. What little difference there is points to a slightly better prognosis in the younger groups. This is expressed in another way in Table 4 which gives the approximate life expectancy of the different age groups. This suggests that the younger ages do have a slightly longer expected lifetime.

II. *Associated Defects.*

The series was subdivided into groups having no preexisting disease and those having preexisting angina, hypertension, other cardiovascular disease (rheumatic heart disease, luetic heart disease, previous cerebrovascular accident, peripheral vascular disease, cor pulmonale), diabetes, and other possibly contributory non-cardiovascular disease (hyperthyroidism, renal disease, gallbladder disease, etc.) Table 5 gives the number and percentage of cases with each associated defect. It will be noted that these add up to more than the total number of cases, since some had more than one defect. Un-

TABLE 5

INCIDENCE OF ASSOCIATED DEFECTS

ASSOCIATED DEFECT	NUMBER OF LIVES	PERCENTAGE
ANGINA	118	7.5
HYPERTENSION	353	22.8
OTHER C-V DISEASE *	53	3.4
DIABETES	57	3.8
NON C-V DISEASE POSSIBLY CONTRIBUTORY **	48	3.1
NONE	981	63.2
TOTAL	1610	

* INCLUDES RHEUMATIC, LUETIC, CONGENITAL AND ARTERIOSCLEROTIC HEART DISEASE, PERIPHERAL VASCULAR DISEASE, PREVIOUS CEREBROVASCULAR ACCIDENT

** INCLUDES HYPERTHYROIDISM, RENAL DISEASE, SEVERE INFECTIONS, SURGICAL OPERATIONS, INJURIES, SHOCK SHORTLY BEFORE ATTACK

TABLE 6
MORTALITY TABLES BY ASSOCIATED DEFECTS

AGE AT ONSET	ANGINA			HYPERTENSION			OTHER C-V DISEASE **		
	RATE PER M/YR.	NO. DEATHS	MORT. RATIO	RATE PER M/YR.	NO. DEATHS	MORT. RATIO	RATE PER M/YR.	NO. DEATHS	MORT. RATIO
TO 49	96	17	750	104	66	800	*	6	*
50-60	116	44	500	130	159	550	153	32	650
TOTAL	109	61	550	121	225	600	151	38	750
DURATION FROM ATTACK (IN YRS.)									
1ST YR.	107	12	700	105	34	700	213	10	1450
2ND YR.	154	15	950	102	30	650	267	10	1650
3RD-5TH	97	18	550	115	75	650	*	9	*
6TH-10TH	103	14	450	148	70	650	*	6	*
11TH+	*	2	*	147	16	450	*	3	*
TOTAL	109	61	550	121	225	600	151	38	750

* RATES NOT CALCULATED SINCE FEWER THAN 10 DEATHS IN GROUP

** INCLUDES RHEUMATIC, LUETIC, CONGENITAL AND ARTERIOSCLEROTIC HEART DISEASE, PERIPHERAL VASCULAR DISEASE, PREVIOUS CEREBROVASCULAR ACCIDENT

TABLE 6a
MORTALITY TABLES BY ASSOCIATED DEFECTS (Cont'd)

AGE AT ONSET	DIABETES			POSSIBLE CONT. NON C-V DISEASE **			NONE		
	RATE PER M/YR.	NO. DEATHS	MORT. RATIO	RATE PER M/YR.	NO. DEATHS	MORT. RATIO	RATE PER M/YR.	NO. DEATHS	MORT. RATIO
TO 49	*	7	*	*	8	*	73	180	600
50-60	105	28	400	120	20	500	82	262	350
TOTAL	106	35	550	125	28	650	78	442	400
DURATION FROM ATTACK (IN YRS.)									
1ST YR	*	8	*	*	3	*	91	83	600
2ND YR.	*	3	*	*	2	*	87	71	550
3RD-5TH	*	9	*	131	11	700	67	122	350
6TH-10TH	117	12	500	242	12	1050	75	120	350
11TH+	*	3	*	*	0	*	94	46	300
TOTAL	106	35	550	125	28	650	78	442	400

* RATES NOT CALCULATED SINCE FEWER THAN 10 DEATHS IN GROUP

** INCLUDES HYPERTHYROIDISM, RENAL DISEASE, SEVERE INFECTIONS, ANESTHESIA, SURGICAL OPERATIONS, SHOCK SHORTLY BEFORE ATTACK, INJURIES

doubtedly the true incidence of each associated defect would have been higher if complete data had been available in every case.

The mortality for each of these groups by age and by survival time is shown in Table 6. The age group 30 - 39 has been included with the 40 - 49 group because of its small number. Where there were fewer than ten deaths, the mortality rate was not calculated since the group was too small to be of any statistical significance.

Again it is apparent that the mortality ratio decreases as the survival time lengthens. In comparing each of the associated defects with the group that had none, it is seen that each associated defect had a slight to moderate effect on the mortality. Preexisting angina has not been found by other investigators to have any significant effect on those surviving the immediate postinfarction period (3, 4, 5, 6). The effect of hypertension on the prognosis has been variable in different studies (7, 8, 9) and as Poindexter (1) pointed out, may be due to the different criteria for hypertension. In this study we

TABLE 7

INCIDENCE OF COMPLICATIONS

COMPLICATION	NUMBER OF LIVES	PERCENTAGE
ANGINA	588	38.3
CONGESTIVE FAILURE	183	11.9
ARRHYTHMIA *	40	2.6
PULMONARY EMBOLISM	45	2.9
PERIPHERAL EMBOLISM	27	1.7
CEREBROVASCULAR ACCIDENT	43	2.8
MISCELLANEOUS **	55	3.7
NONE	713	47.1
TOTAL	1694	

* DOES NOT INCLUDE AURICULAR AND VENTRICULAR ECTOPIC BEATS

** INCLUDES VENTRICULAR ANEURYSM, SHOULDER–HAND SYNDROME, PNEUMONIA, ETC.

used 150/95 as the lower limits of hypertension. Diabetes was thought by Doscher and Poindexter (1) to be of no significance. Katz, et al (3) state that, in those surviving more than two months, diabetes showed only a slight adverse effect.

III. *Complications.*

Our series has also been subdivided into those showing no complications and those with postinfarction angina, congestive failure, arrhythmias, pulmonary embolism, peripheral embolism, cerebral vascular accident, and a miscellaneous group (ventricular aneurysm, pneumonia, shoulder-hand syndrome). Table 7 shows the number and percentage of the various complications. Table 8 presents the results of the mortality analysis of this group. A surprising and paradoxical finding resulted in the group with postinfarction angina. This category showed not only a better mortality than any other of the groups with complications, but also better than those with no complications at all. Two suggestions have been made to explain this. First, these people, as a result of the angina take better care of themselves. Second, the symptom of angina lends itself readily to deliberate or unconscious malingering, and, since this is a group receiving disability payments, it might be expected that some who are otherwise doing very well following their attack would use this symptom to prolong their disability. We are inclined to accept the second explanation.

Congestive failure occurring at any time in the postinfarction period increased the mortality far more than any other complication. This is in agreement with the results of other studies (3, 4, 5, 9).

Except for the groups with pulmonary embolism and miscellaneous complications, which were small and of doubtful statistical significance, all the groups with complications had a higher mortality than those with no complications.

IV. *Group With No Associated Defects or Complications.*

One would expect that those cases having neither preexisting disease nor complications following infarction would show a

TABLE 8
MORTALITY BY COMPLICATIONS

AGE AT ONSET	ANGINA			CONGESTIVE FAILURE			ARRHYTHMIA **			PULMONARY EMBOLISM		
	RATE PER M/YR.	NO. DEATHS	MORT. RATIO	RATE PER M/YR.	NO. DEATHS	MORT RATIO	RATE PER M/YR.	NO. DEATHS	MORT. RATIO	RATE PER M/YR.	NO. DEATHS	MORT. RATIO
TO 49	75	103	600	173	36	1350	*	8	*	89	14	700
50-60	76	191	300	184	105	750	112	15	450	*	8	*
TOTAL	76	294	400	181	141	900	114	23	600	85	22	450
DURATION FROM ATTACK (IN YRS)												
IST YR.	47	25	300	186	31	1250	*	3	*	*	4	*
2ND YR.	63	32	400	209	29	1300	*	2	*	*	1	*
3RD-5TH	63	79	350	134	35	750	*	7	*	*	4	*
6TH-10TH	93	109	400	199	36	850	189	10	800	*	7	*
11TH+	121	49	400	328	10	1050	*	1	*	*	6	*
TOTAL	76	294	400	181	141	900	114	23	600	85	22	450

* RATE NOT CALCULATED SINCE FEWER THAN 10 DEATHS
** DOES NOT INCLUDE AURICULAR AND VENTRICULAR ECTOPIC BEATS

TABLE 8a
MORTALITY BY COMPLICATIONS (Cont'd)

AGE AT ONSET	PERIPHERAL EMBOLISM			CEREBROVASCULAR ACCIDENT			OTHER **			NONE		
	RATE PER M/YR	NO. DEATHS	MORT. RATIO	RATE PER M/YR	NO. DEATHS	MORT. RATIO	RATE PER M/YR.	NO. DEATHS	MORT. RATIO	RATE PER M/YR.	NO. DEATHS	MORT. RATIO
TO 49	*	7	*	117	15	900	*	8	*	78	128	600
50-60	181	13	750	197	19	800	76	15	300	100	203	400
TOTAL	169	20	850	151	34	800	75	23	400	90	331	450
DURATION FROM ATTACK (IN YRS)												
IST YR.	*	3	*	*	6	*	*	3	*	115	79	750
2ND YR.	*	3	*	*	3	*	*	1	*	107	62	650
3RD-5TH	*	9	*	*	9	*	*	9	*	84	102	450
6TH-10TH	*	5	*	222	12	950	*	9	*	78	76	350
11TH+	*	0	*	*	4	*	*	1	*	51	12	150
TOTAL	169	20	850	151	34	800	75	23	400	90	331	450

* RATE NOT CALCULATED SINCE FEWER THAN 10 DEATHS IN GROUP
** INCLUDES VENTRICULAR ANEURYSM, SHOULDER-HAND SYNDROME, PNEUMONIA, ETC.

lower mortality rate than any other of the groups. Table 9 gives the mortality of this group from our series. In the first two survival years this group is no better — and is even worse than the whole group. This defies explanation. However, from the third year on, there is a definitely lower mortality rate, especially in the 50 - 60 age group, which falls within an insurable range.

TABLE 9

MORTALITY OF GROUP HAVING
NO ASSOCIATED DEFECTS AND NO COMPLICATIONS

DURATION FROM ATTACK (IN YEARS)	AGE AT ONSET: 30–49			50–60			TOTAL		
	RATE PER M/YR.	NO. DEATHS	MORT. RATIO	RATE PER M/YR	NO. DEATHS	MORT. RATIO	RATE PER M/YR	NO. DEATHS	MORT. RATIO
1	98	20	1100	114	34	650	108	54	700
2	61	11	650	115	28	600	92	39	600
3–5	68	29	650	69	32	300	69	61	400
6–10	67	27	450	61	21	200	64	48	300
11+	35	5	150	65	4	150	44	9	150
TOTAL	68	92	550	84	119	350	76	211	400

It would have been desirable to have subdivided this group further according to certain electrocardiographic characteristics, but the individual groups would have become too small to be of any significance.

V. *Electrocardiographic Findings.*

An attempt has been made to correlate the electrocardiogram with the mortality. Twelve hundred and seven cases were available for electrocardiographic analysis. In the remaining 344 cases, no electrocardiogram was available for study. Of the latter group, 205 were said to have had positive electrocardiograms while 139 were not reported. This group

of 344 cases is a select one in that its clinical features were judged very strictly to determine the validity of the diagnosis. Cases of this type with more obvious and more severe clinical manifestations will therefore tend to predominate where there is no confirmatory electrocardiogram. One would naturally expect this group to have a higher mortality. This is borne out as shown in Table 10. Another group of 169 had abnormal but nondiagnostic electrocardiograms and similarly were more rigidly selected than the group with the diagnostic electrocardiogram. Obviously therefore, the group that has been analyzed according to electrocardiographic characteristics omits many of the severe cases. This fact should be kept in mind when considering the results of our mortality study within this group of 1,207 cases.

TABLE 10

MORTALITY IN THOSE CASES IN WHICH NO EKG REPORTED OR REPORTED "POSITIVE" BUT NOT SEEN (344 CASES)

DURATION FROM ATTACK	DEATH RATE PER M/YR.	ACTUAL DEAD	MORTALITY RATIO
1ST YEAR	259	72	1750
2ND YEAR	177	37	1100
3RD – 5TH YEAR	127	57	700
6TH – 10TH YEAR	117	50	500
11TH+	61	12	200
TOTAL	146	228	750

The entire group for electrocardiographic analysis was subdivided into three groups: 1) diagnostic, 2) abnormal but nondiagnostic, and 3) normal. Table 11 shows the mortality of the group analyzed according to both age of onset and duration from onset. The nondiagnostic group has the

TABLE 11

MORTALITY PER YEAR BY EKG INTERPRETATION

AGE AT ONSET	DIAGNOSTIC (1015 CASES)			ABNORMAL BUT NON-DIAGNOSTIC (169 CASES)			NORMAL (23 CASES)		
	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO
TO 49	75	163	600	71	20	550	*	4	*
50–60	79	274	300	106	71	450	*	8	*
TOTAL	77	437	400	95	91	500	61	12	300
DURATION FROM ATTACK (IN YRS.)									
1ST YR.	59	57	400	72	11	500	*	1	*
2ND YR.	76	67	450	83	12	500	*	1	*
3RD-5TH	70	134	400	89	30	500	*	1	*
6TH-10TH	86	132	350	125	33	550	*	3	*
11TH+	131	47	400	*	5	*	*	6	*
TOTAL	77	437	400	95	91	500	61	12	300

* RATE NOT CALCULATED SINCE FEWER THAN 10 DEATHS

highest mortality but this is probably because of the selection factor mentioned previously. Others (1, 3, 10, 11) have found, however, that in the presence of an indefinite electrocardiographic pattern the mortality rate is higher, perhaps because these patterns are frequently associated with multiple or previous infarcts.

It is evident that the mortality ratio remains essentially level regardless of the length of survival. This is true for all the groups studied by electrocardiogram, with one exception, namely, those with postinfarction "healed pattern unknown". This is in contrast to the mortality as analyzed for the total group of 1,551 cases and by associated defects and complications. It is accounted for by the exclusion of the 344 cases with no electrocardiogram which, as we have previously pointed out, are the worst group with the highest mortality in the early years after the attack. This is again confirmed by a separate mortality study (Table 9) of the group with no electrocardiogram in which the mortality is very high in the early years.

One thousand and seventeen cases were available for analysis according to the location of the infarct. Approximately 50 per cent were anterior, 43 per cent were posterior, and 7 per cent were combined, mixed, or indeterminate. Table 12 gives the mortality for these groups. The mixed group shows the highest mortality while the posterior infarctions have the lowest mortality. The difference is not very great, a finding in keeping with most previous investigations (2, 3, 6).

TABLE 12

MORTALITY BY LOCATION OF INFARCT

AGE AT ONSET	ANTERIOR (510 CASES)			POSTERIOR (432 CASES)			MIXED (73 CASES) **		
	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO
TO 49	77	78	600	74	72	600	65	13	500
50-60	85	146	350	67	100	300	102	28	400
TOTAL	82	224	400	70	172	350	87	41	450
DURATION FROM ONSET (IN YRS.)									
IST YR.	78	38	500	44	18	300	*	1	*
2ND YR.	76	33	450	69	26	450	*	8	*
3RD-5TH	66	61	350	75	62	400	67	11	350
6TH-10TH	94	69	400	75	51	350	91	12	400
11TH+	159	23	500	86	15	250	*	9	*
TOTAL	82	224	400	70	172	350	87	41	450

* RATE NOT CALCULATED SINCE FEWER THAN 10 DEATHS

** INCLUDES COMBINED TYPES AND THOSE NOT DEFINITELY LOCALIZED

It appears to be a general assumption that cases in which the electrocardiogram returns to normal fare better than those in which it remains abnormal. Of the 1,184 cases with diagnostic, or abnormal but not diagnostic electrocardiograms, there were only 702 with sufficient followup to determine whether or not it returned to normal. Tables 13 and 14 show the result of this analysis. The mortality of the cases with a diagnostic electrocardiogram which returned to normal was somewhat better than those in which it remained abnormal. The number of cases with electrocardiograms returning to normal was small, being approximately 14 per cent of all cases having electrocardiographic followup.

TABLE 13

DIAGNOSTIC EKG (1015 CASES)

AGE AT ONSET	RETURNED TO NORMAL IN 6 MOS. (76 CASES)			DID NOT RETURN TO NORMAL IN 6 MOS. (534 CASES)			HEALED PATTERN UNKNOWN (405 CASES)		
	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO
TO 49	58	13	450	66	83	500	95	67	750
50–60	48	14	200	68	145	300	110	115	450
TOTAL	52	27	250	67	228	350	104	182	550
DURATION FROM ONSET (IN YRS.)									
1ST YR.	*	1	*	*	9	*	122	47	800
2ND YR.	*	3	*	60	30	350	109	34	700
3RD-5TH	*	8	*	60	69	350	96	57	555
6TH-10TH	75	12	350	82	79	350	99	41	450
11+ YR.	*	3	*	151	41	450	*	3	*
TOTAL	52	27	250	67	228	350	104	182	550

* RATE NOT CALCULATED SINCE FEWER THAN 10 DEATHS

TABLE 14

ABNORMAL BUT NON-DIAGNOSTIC EKG (169 CASES)

AGE AT ONSET	RETURN TO NORMAL IN 6 MOS. (21 CASES)			DID NOT RETURN TO NORMAL IN 6 MOS. (71 CASES)			HEALED PATTERN UNKNOWN (77 CASES)		
	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO	DEATH RATE PER M/YR.	ACTUAL DEAD	MORT. RATIO
TO 49	*	1	*	70	10	550	*	9	*
50-60	93	11	400	81	25	350	143	35	600
TOTAL	83	12	400	78	35	400	122	44	600
DURATION FROM ONSET (IN YRS.)									
1ST YR.	*	3	*	*	1	*	*	7	*
2ND YR.	*	1	*	*	4	*	*	7	*
3RD-5TH	*	3	*	68	11	400	124	16	700
6TH-10TH	*	3	*	131	17	550	144	13	650
11TH+	*	2	*	*	2	*	*	1	*
TOTAL	83	12	400	78	35	400	122	44	600

* RATE NOT CALCULATED SINCE FEWER THAN 10 DEATHS

Most surprising was the fact that those in which the healed electrocardiographic pattern was unknown showed by far the highest mortality. It is apparent that this must be a selected group, with many cases in which the clinical severity and subsequent disability were so obvious that no further electrocardiogram was thought to be necessary. This is made further apparent by the fact that this is the only group analyzed by electrocardiogram which shows the expected trend of declining mortality ratio as survival time increases.

We believe the results of this investigation indicate little or no significant correlation between the electrocardiogram and the ultimate prognosis. Granted that several groups show a better or worse mortality than other groups, the differences are rarely large, not always consistent, and sometimes are accounted for by certain factors such as the smallness of several groups, or a selection factor in other groups.

VI. *Causes of Death.*

Table 15 shows the cause of death analyzed according to length of survival. The group "acute cardiac deaths" includes

TABLE 15

CAUSE OF DEATH

DURATION FROM ATTACK (IN YRS.)	ACUTE * CARDIAC	CONGESTIVE FAILURE	CEREBRO-VASCULAR ACCIDENT	PULMONARY EMBOLISM	UNRELATED	UNKNOWN	TOTAL
1ST. YR.	98	23	3	4	8	6	142
2ND YR.	68	23	6	–	7	13	117
3RD - 5TH	147	29	8	1	18	20	223
6TH - 10TH	123	33	13	6	21	23	219
11TH+	40	13	5	1	7	4	70
TOTAL	476	121	35	12	61	66	771
	(61.7%)	(15.7%)	(4.5%)	(1.6%)	(7.9%)	(8.6%)	(100%)

* ACUTE CARDIAC DEATHS INCLUDE ALSO THE SUDDEN UNEXPLAINED DEATHS

WALDRON Mutual Life 1950
1551 Cases

all the sudden unexplained deaths but is made up mostly of those with fresh coronary occlusions and infarctions. The table is otherwise self-explanatory, showing that cardiovascular disease accounted for 83.5 per cent of all deaths. This would probably have been even higher if information had been available on the "unknown" group.

Summary and Conclusions

1. One thousand five hundred and fifty-one cases of myocardial infarction surviving three months or longer were reviewed as to complications, associated defects, and electrocardiographic findings and their effect on mortality.

2. The mortality rate was very high.

3. Those with various preexisting associated defects had a slightly higher mortality.

4. Those with various complications also appear to have had a slightly higher mortality. This was especially true in those complicated by congestive failure.

5. The group having neither associated defects nor complications had considerably lower mortality than the overall group after two years survival.

6. The electrocardiogram did not appear to have any great prognostic value, although cases in which the pattern returned to normal in six months had the lowest mortality. However, this group was so small that the significance is questionable.

7. The mortality ratios for the younger age groups were considerably higher than those for the older ages. This surprising fact is contrary to what we had previously assumed.

8. The mortality ratios tended to decrease as the survival time lengthened.

9. The difference between age groups in the actual mortality rate from the disease is very slight with the younger ages having possibly a slightly lower rate.

10. Mortality tables are presented for the various groups.

REFERENCES

1. Doscher, Ned and Poindexter, C. A.: Myocardial infarction without anticoagulant therapy, Am. J. Med. 8:5, 623 (May) 1950.
2. Levine, S. A. and Rosenbaum, F. F.: Prognostic value of various clinical and electrocardiographic features of acute myocardial infarction II ultimate prognosis, Arch. Int. Med. 68:6, 1215 (1941).
3. Katz, L. N., Mills, G. Y. and Cisneros, F.: Survival after recent myocardial infarction, Arch. Int. Med. 84:305 (1949).
4. Rathe, H. W.: Myocardial infarction: its clinical features and prognosis, J. A. M. A. Vol. 120:2199 (1942).
5. Billings, F. T., Kalstone, B. M., Spencer, J. L., Ball, C. O. T. and Meneely, G. P.: Prognosis of acute myocardial infarction, Am. J. Med. 7:356 (Sept.) 1949.
6. Willius, F. A.: Life expectancy in coronary thrombosis, J. A. M. A. Vol. 106:22, 1890 (1936).
7. Bland, E. F. and White, P. D.: Coronary thrombosis (with myocardial infarction) ten years later, J. A. M. A. Vol. 117:14, 1171 (1941).
8. Zinn, W. J. and Cosby, R. S.: Myocardial infarction: statistical analysis of 679 autopsy-proven cases, Am. J. Med. 8:2, 169 (1950).
9. Master, A. M., Dack, S. and Jaffee, H. L.: Coronary thrombosis: an investigation of heart failure and other factors with course and prognosis, Am. Heart J. 3:3, 330 (1937).
10. Woods, R. M. and Barnes, A. R.: Factors influencing immediate mortality after acute coronary occlusion, Am. Heart J. 24:1, 4 (1942).

PRESIDENT UNGERLEIDER — The next paper should be of interest to everyone. This will be a presentation of certain mortality experience by Dr. William Bolt, Chief Medical Director, and Dr. Murray F. Bell, Assistant Medical Director, New York Life Insurance Company. Dr. Bell will present their paper on "Prognostic Import of a Large Q_3 Deflection: A Mortality Study."

PROGNOSTIC IMPORT OF A LARGE Q_3 DEFLECTION: A MORTALITY STUDY*

William Bolt, M. D.

Chief Medical Director

and

Murray F. Bell, M. D.

Assistant Medical Director

New York Life Insurance Company,

New York City

Electrocardiograms presenting a large Q_3 deflection, unassociated with other abnormalties, have proven most difficult to evaluate. Opinions relative to the significance of this finding, particularly in otherwise apparently normal individuals, have varied. The importance of this problem is enhanced in insurance medicine, inasmuch as past clinical history and data are at times unobtainable or unreliable, and a decision as to insurability of the individual must be made from information available.

In 1930, Pardee (1) defined the large Q wave in lead 3 of the electrocardiogram as follows:

1. Q_3 should be 25 per cent or more of the greatest deflection from the base line of the QRS in any lead.
2. No records should have R_3 greater than R_2; none should show right axis deviation.
3. An R_3 must succeed the Q_3, and S_3 must be absent.
4. No vibratory or irregular QRS complexes of the M or

*The authors are indebted to Mr. John Ryan and his associates for their analysis of the statistical data.

W types in lead 3 should be present.

Pardee stressed the high incidence of angina pectoris in individuals presenting such a Q_3 finding. In a series of cases studied by Willius (2), hypertension and coronary disease predominated. In a composite group of 977 normal individuals, including cases of Pardee, Wolferth and Willius (2), a large Q_3 appeared rarely (0.2 per cent). Groups of healthy young aviators studied by Stewart and Manning (3), and Graybiel and Gates (4) supported this observation. Fenichel and Kugel (5) correlated the electrocardiogram with pathologic findings, and concluded in 1931 that the large Q_3 is the most frequent electrocardiographic sign of coronary artery disease during the chronic period. Carr, Hamilton and Palmer (6) found a comparatively frequent occurrence of a large Q_3 during pregnancy in individuals with normal hearts. They suggested that this finding in their patients may be related to a transverse position of the heart such as occurs with pregnancy. France (7) stressed the fact that coronary disease and hypertension often occur in the elderly, obese, thick-set individual, so that lateral displacement of the heart must be considered in this type, before placing too much significance on a Q_3 which might be present. Shookhoff and Douglas (8) and Mazer and Reisinger (9) also pointed out the difficulty in evaluating the significance of an isolated deep Q_3 abnormality, based on the electrocardiogram alone.

Attempts to identify abnormal Q_3 waves more accurately led to additional criteria. Supportive findings in lead 2 are of course most helpful (10, 11) but some difficulty arises when such lead 2 changes are absent or inconclusive. Bayley (12) emphasized the importance of a wide Q wave, .04 sec. or more. In addition to these, Ungerleider and Gubner (13) have recently brought attention to the added significance of Q_3 when it is unaccompanied by an S wave in lead 1. Unipolar extremity leads (14–21) and esophageal leads (17) have also attained usefulness in distinguishing normal from abnormal Q_3 waves, and in explaining the mechanism concerned in the genesis of both the normal and abnormal Q_3, i. e., (a) Q_3 produced by posterior infarction and (b) Q_3 occurring as a

result of horizontal position of either a normal sized or enlarged heart. In 1949, Myers, Klein and Hiratzka (22), correlated electrocardiographic and postmortem findings and stated: "The application of the Pardee criteria to the interpretation of the findings in the standard leads led to errors in a number of cases where correct diagnoses could be made from the finding in lead AVF." However, in the same year 1949, Lowen and Pardee (23) stated, "In records from cases of posterior infarction, the unipolar leads were less useful than the conventional leads in arriving at the correct diagnosis. The failure of AVF to have the features considered significant of disease in so many records from patients with infarction, makes it probable that it would be equally unreliable in determining the presence or absence of disease in those doubtful cases which have Q_3 as the only abnormality." To continue, Adams (24), in 1949, stated, "The frequent association of a prominent Q_3 with posterior infarction gave rise to numerous erroneous unfavorable prognoses before it was recognized that many such waves were the result of completely innocuous rotations of the heart." Yet, Ungerleider and Gubner (13), on the basis of a limited mortality study, concluded in 1947 that the Q_3 deflection is an unfavorable prognostic sign and a significant abnormality which should not be dismissed simply because of associated overweight and transverse position of the heart.

A further mortality study was undertaken by us in an attempt to clarify the prognostic significance of the large Q_3.

Material and Methods

A total of 340 cases was studied. The subjects consisted of insurance applicants and disability claimants. They had been examined and their electrocardiograms recorded at some time during the period from 1930 to 1941. In addition to the electrocardiogram, each had a history, physical examination, a chest x-ray and/or fluoroscopy. The cases were divided into two basic groups. Group I consisted of 209 cases. They presented no other demonstrable abnormalities and volunteered no significant history. Eleven (5.3 per cent) were not successfully traced, leaving a total of 198 (94.7 per cent)

successfully followed. All were insurance applicants. The electrocardiograms in this group were made either because the amount of insurance involved was large or as part of a cardiac survey for an innocuous murmur or borderline labile blood pressure elevation. Group II consisted of 131 cases. They presented one or more associated cardiovascular abnormalities, such as significant history, arterial hypertension, organic murmurs, cardiac enlargement. Five (3.8 per cent) were not successfully traced, leaving a total of 126 (96.2 per cent) successfully followed. Of these, 27 were insurance applicants and 99 were disability claimants.

The electrocardiograms of both groups demonstrated a large Q_3. This Q_3 satisfied the Pardee criteria, except that tracings presenting a QS deflection were included. The electrocardiograms consisted of three standard limb leads and one to three precordial leads predominantly of the CF type. Although we have been using unipolar extremity leads for several years, none of the tracings in this study included such leads. There were no additional conclusive abnormalities present in the curves upon which one could base a definite opinion. With respect to additional criteria, however, the tracings of each group were further subdivided as follows: Q_3 under .04 sec. in width accompanied by S_1 with Q_2 absent; Q_3 unaccompanied by S_1; Q_3 associated with a Q_2 of not more than 19 per cent of R_2; Q_3 widened to .04 sec. or more; and combinations of the above.

Table A presents the statistical data of the two major groups, i. e., Group I — unassociated with clinical cardiovascular abnormality. (So-called Normal Group.) Group II — associated with clinical cardiovascular abnormality. (Abnormal Group.)

The cases were arranged in decennial age subdivisions. Group I included subjects predominantly in the 31–60 year age category, and in Group II they were principally 41–60 years of age. Since there were so few females in the study it was not necessary to separate the data by sex. The height and weight of each individual were recorded. Although both Groups I and II were somewhat above average weight, test

TABLE A

RATIOS OF ACTUAL TO EXPECTED DEATHS BY AGE GROUPS
ALL SPECIAL Q WAVE CATEGORIES COMBINED

(Expected Deaths Based on Company Experience under Standard Issues)

Age Group at EKG.	Total Cases	Total Cases Traced	Total Cases Untraced	DEATHS FROM ALL CAUSES			CARDIAC DEATHS		
				Actual Deaths	Expected Deaths	Ratio of Actual to Expected Deaths	Actual Deaths	Expected Deaths	Ratio of Actual to Expected Deaths
GROUP I — (Normal)									
21–30	7	7	0	0	.196	—	0	.01	—
31–40	54	53	1	3	2.274	132%	2	.50	400%
41–50	92	86	6	9	8.758	103	5	2.98	168
51–60	48	45	3	9	12.232	74	5	3.42	146
61–70	8	7	1	5	2.593	193	2	.73	274
Total	209	198	11	26	26.053	100%	14	7.64	183%
GROUP II — (Abnormal)									
21–30	0	0	0	0	—	—	0	—	—
31–40	13	12	1	1	.616	162%	1	.14	714%
41–50	51	49	2	12	4.904	245	10	1.67	599
51–60	59	57	2	25	11.622	215	17	3.25	523
61–70	8	8	0	2	4.850	41	2	1.36	147
Total	131	126	5	40	21.992	182%	30	6.42	467%

TABLE B

RATIOS OF ACTUAL TO EXPECTED DEATHS BY SPECIAL Q WAVE CATEGORIES
ALL AGES COMBINED

(Expected Deaths Based on Company Experience under Standard Issues)

Special Q Wave Category	Total Cases	Total Cases Traced	Total Cases Untraced	DEATHS FROM ALL CAUSES			CARDIAC DEATHS		
				Actual Deaths	Expected Deaths	Ratio of Actual to Expected Deaths	Actual Deaths	Expected Deaths	Ratio of Actual to Expected Deaths
GROUP I — (Normal)									
A	97	94	3	11	11.516	96%	3	3.34	90%
C, E, F, CE & EF	112	104	8	15	14.537	103	11	4.30	256
TOTAL	209	198	11	26	26.053	100%	14	7.64	183%
GROUP II — (Abnormal)									
A′	39	39	0	11	5.504	200%	7	1.68	417%
C′	25	23	2	7	3.475	201	6	1.02	588
E′	25	24	1	6	3.327	180	3	.97	309
F′	19	17	2	5	4.556	110	4	1.29	310
CE′	13	13	0	6	2.336	257	5	.67	746
EF′	10	10	0	5	2.794	179	5	.79	633
TOTAL	131	126	5	40	21.992	182%	30	6.42	467%

A — A′ = Q_3 under .04 sec. in width, accompanied by S_1 with Q_2 absent.
C — C′ = Q_3 unaccompanied by S_1.
E — E′ = Q_3 accompanied by Q_2 of not more than 19% R_2.
F — F′ = Q_3 widened to .04 sec. or more.

calculations indicated that this factor probably affected the mortality ratios only slightly, and hence it was disregarded in making the final calculations. The task of tracing the cases was completed in 1949. In view of the fact that some of the individuals were followed from 1930 and others from 1941, allowance was made for the differences in length of exposure of the cases. The deaths were separated into two categories, i.e., those resulting from heart disease and those from other causes. The number of deaths from all causes was compared with the expected death rate. Similarly, the number of deaths from cardiac disease was compared with the expected cardiac death rate. The expected death rates were based on actuarial tables of the New York Life Insurance Company, covering the same period of exposure as the cases in the study.

Table B presents the subdivision of both Groups I and II, all ages combined, into special categories with respect to additional Q wave criteria, as defined in the footnote.

Results and Discussion

The results as shown in Tables A and B may be summarized as follows. With respect to Group I, the so-called normal group, the cardiac mortality experience was well above normal — 183 per cent. When the cases in this group were subdivided according to additional criteria (see footnote Table B), 94 of the total of 198 cases comprised the A category, i. e., deep Q_3, under .04 sec. in width, accompanied by S_1, and unassociated with even a small Q_2. This category sustained only 90 per cent of the normally expected cardiac death rate, suggesting the benignity of this type of Q_3 deflection. On the other hand, the remaining categories, both individually and as a group, sustained a significantly excessive cardiac death rate computed as 256 per cent for the total of 104 cases. In spite of this definitely increased mortality from cardiac causes, it is noted that the deaths from all causes combined were not excessive. It should be emphasized that there were 11 cases in this group which we failed to trace, despite concentrated effort. Furthermore, the number of cases is of course small from a statistical standpoint.

Upon analysis of the above data, we thought it would be of interest to study a group of cases presenting similar electrocardiographic findings but manifesting associated clinical cardiovascular abnormalities. We realized, of course, that because of the variations in the severity of the associated pathology, no valid statistical conclusions could be drawn as to the relative importance of each of the electrocardiographic categories in relation to the excessive cardiac deaths. Nevertheless, it was thought that upon breakdown of the data into similar categories as the normal group, some inference as to the prognostic import of the various types of the large Q_3 might be suggested. As seen in Table A, the cardiac mortality experience was markedly excessive — 467 per cent. The overall mortality from all causes was 182 per cent. Five cases could not be traced. Upon subdivision of the cases in Table B, the high cardiac death rate prevailed in all categories, even the A′ one, comparable to the benign type of Q_3 as defined in the normal Group I. Other than the observation that there was a lesser incidence of this benign type of Q_3 in the abnormal group as compared with the normal one, no additional information concerning its prognostic import could be derived from these data.

Summary and Conclusions

1. We have presented a limited mortality study of 340 cases of which 324 were successfully traced. In all cases, a large Q_3 was demonstrated in the electrocardiogram. There were no other definitely abnormal features in these tracings. No unipolar extremity leads were available in these records.

2. Group I, 198 cases, with no associated significant history or cardiovascular abnormality, experienced a cardiac death rate well above normal — 183 per cent, as based upon actuarial tables. Further analysis of this group was made with respect to additional criteria. From this data it is concluded that if the Q_3 is less than .04 sec. in duration, and occurs in the absence of a Q_2 but in the presence of an S_1 deflection, it does not in itself constitute a reliable sign of heart disease, and warrants no basis for unfavorable prognosis. On the other hand, if the Q_3 is either widened, or accompanied by even a

small Q_2, or occurs in the absence of S_1, it undoubtedly reflects a definite cardiac abnormality in many individuals. The segment of the so-called normal group presenting this latter type of Q wave sustained a significantly excessive cardiac death rate of 256 per cent.

3. Group II, 126 cases, with associated abnormal cardiovascular clinical data, experienced, as expected, a markedly excessive death rate from cardiac causes — 467 per cent. Further analysis of this group was made with respect to additional criteria. Because of variations in the severity of the clinical cardiovascular abnormalities present in the cases of this entire group, it was realized that no valid statistical conclusion could be drawn as to the relative importance of each of the variations in the electrocardiographic findings in relation to the excessive cardiac deaths in all categories. Nevertheless, an analysis of the data was undertaken in the hope that some further information might be derived. Aside from a lesser incidence of the so-called benign type of Q_3, as compared to the normal group, no additional knowledge regarding its prognostic import could be obtained.

REFERENCES

1. Pardee, H. E. B..: The Significance of an Electrocardiogram with a Large Q in Lead 3, Arch. Int. Med. 46:470, 1930.
2. Willius, F. A.: Occurrence and Significance of Electrocardiograms Displaying Large Q Waves in Lead 3, Am. Heart Jl. 6:723, 1931.
3. Stewart, C. B. and Manning, G. W.: A Detailed Analysis of the Electrocardiograms of 500 R. C. A. F. Aircrew, Am. Heart Jl. 27:502, 1944.
4. Graybiel, A. and Gates, P. C.: Analysis of the Electrocardiograms obtained from 1,000 Young Healthy Aviators, Am. Heart Jl. 27:524, 1944.
5. Fenichel, N. M. and Kugel, V. H.: The Large Q Wave of the Electrocardiogram: A Correlation with Pathological Observations, Am. Heart Jl. 7:235, 1931.
6. Carr, F. B., Hamilton, B. E. and Palmer, R. S.: The Significance of a Large Q in Lead 3 of the Electrocardiogram, Am. Heart Jl. 8:519, 1933.
7. France, R.: The Large Q Wave in Lead 3 of the Electrocardiogram, Am. Jl. Med. Sc. 187:16, 1934.
8. Shookhoff, C. and Douglas, A. H.: Q Deflections in Normal and Abnormal Human Electrocardiograms, Ann. Int. Med. 8:177, 1934.

9. Mazer, M. and Reisinger, J. A.: Criteria for Differentiating Deep Q_3 Electrocardiograms from Normal and Cardiac Subjects, Am. Jl. Med. Sc. 206:48, 1943.
10. Wallace, A. W.: The Q Wave in the Electrocardiogram, Am. Jl. Med. Sc. 4:498, 1934.
11. Durant, T. M.: The Initial Ventricular Deflection of the Electrocardiogram in Coronary Disease, Am. Jl. Med. Sc. 188:225, 1934.
12. Bayley, R. H.: The Significance of the Duration of Q_3 with Respect to Coronary Disease, Am. Heart Jl. 18:308, 1939.
13. Ungerleider, H. E. and Gubner, R.: The Q_3 and QS_3 Deflections in the Electrocardiogram: Criteria and Significance, Am. Heart Jl. 33:807, 1947.
14. Wilson, F. N., MacLoed, A. G., Barker, P. S., Johnston, F. D. and Klostermeyer, L. L.: The Electrocardiogram in Myocardial Infarction, with Particular Reference to the Initial Deflection of the Ventricular Complex, Heart 16:155, 1933.
15. Wilson, F. N., Johnston, F. D., MacLoed, A. G. and Barker, P. S.: Electrocardiograms that Represent the Potential Variation of a Single Electrode, Am. Heart Jl. 9:447, 1934.
16. Kossman, C. E. and de la Chapelle, C. E.: The Precordial Electrocardiogram in Myocardial Infarction: II Observations on Cases of Infarction of the Posterior Wall of the Left Ventricle, Am. Heart Jl. 18:344, 1939.
17. Nyboer, J.: The Normal and Abnormal Esophageal Electrocardiogram with Particular Reference to Myocardial Infarction, Am. Heart Jl. 22:469, 1941.
18. Goldberger, E.: The Use and Advantages of Augmented Unipolar Extremity Leads in the Electrocardiographic Diagnosis of Myocardial Infarction, N. Y. State Jl. of Med. 43:961, 1943.
19. Lyle, A. M.: Further Observation on the Deep Q_3 of the Electrocardiogram, Am. Heart Jl. 28:199, 1944.
20. Myers, G. B. and Oren, B.: The Use of Augmented Unipolar Left Leg Lead in the Differentiation of the Normal from Abnormal Q_3 Wave in Standard Lead 3, Am. Heart Jl. 29:708, 1945.
21. Goldberger, E.: The Differentiation of Normal from Abnormal Q Wave, Am. Heart Jl. 30:335, 1945.
22. Myers, G. B., Klein, H. A. and Hiratzka, T.: Correlation of Electrocardiographic and Pathological Findings in Posterior Infarction, Am. Heart Jl. 38:547, 1949.
23. Lowen, H. J. and Pardee, H. E. B.: Unipolar Extremity Leads in Records with Large Q_3, Annals Int. Med. 31:456, 1949.
24. Adams, W. R.: The Clinical Application of Electrocardiography, Mod. Concepts of Cardiovascular Disease, 18:47, 1949.

PRESIDENT UNGERLEIDER — Thank you, Dr. Bell.

DR. GUBNER — Dr. Bolt and Dr. Bell have performed a very useful and very necessary service in elaborating the mortality significance of the Q_3 deflection. Their results confirm the study Dr. Ungerleider and myself reported some

years ago on a more limited scale. We were unable to carry out a mortality study, but our findings indicated that there was a considerable excess of cardiac deaths among subjects with a Q_3, particularly when the associated findings, such as a Q_2, absence of an S_1, and wide Q_3, such as Dr. Bell discussed, were present.

Primarily, I should like to call attention to one point that may be useful to those faced with the problem of Q_3. We now have somewhat more substantial criteria as a guide in the presence of a Q_3, namely, the unipolar extremity leads. Unfortunately, except in the metropolitan area, we frequently cannot obtain this type of lead.

I would like to emphasize that substantially the same information may be obtained by a V lead with the exploring electrode placed over the left lumbar area, or over the left kidney. This gives exactly the same information as the AVL, or unipolar left leg lead. I have never seen a case abnormal in the left leg lead which has not also revealed abnormality with the terminal placed below the diaphragm on the left side. It indicates also a posterior window of infarction, and it is a simple procedure to use, and as long as AV leads are not available, this can be requested.

Dr. Edward A. Keenleyside — I would like to ask Dr. Bell how small a Q_2 could be and still be considered significant.

Dr. Howard Brown — May I ask if anyone would venture an opinion regarding a diagnostic opinion of Q in AVF. The Prudential Insurance Company, as you know, has presented a very fine symposium on unipolar leads and I wonder if someone from the Prudential would discuss the subject.

Dr. Charles E. Kiessling — I have nothing to say. We use the AVF lead if we can get it. Most of the time we find that is a more reliable criterion than the Q_3.

President Ungerleider — What do you do when you get the electrocardiograms in the field and you cannot get the AVF?

Dr. Kiessling — We have to use the same criteria that Dr. Bell spoke of.

DR. BELL — With respect to the first question as to how small a Q_2 was before it was considered significant, we accepted such a wave as demonstrating some Q wave when it was more than a half millimeter in amplitude. As far as its maximum went, that was based on the size of the wave.

With respect to the unipolar lead, AVF, which we are now using routinely at the home office, and which we obtain elsewhere as frequently as we can, we use the criteria of Dr. Gordon Meyers and his group. In this, I believe, he states that if this Q wave in AVF is more than 25 per cent of the subsequent R wave, and is also .04 sec. or more in width, he considers that significant. If it has either one of these criteria alone, either in amplitude or in width, he considers it highly suggestive. However, he does state that when the waves are very small, less than 5 mm. in total amplitude, he considers any of the findings in this lead to be unreliable.

These are the types of cases in which, even with all our exploratory leads, including AVF, we are forced to go back again to the standard leads to arrive at a decision.

DR. UNGERLEIDER — Our next speaker bears the title of consultant, division of medicine at the Mayo Clinic. This in itself is a guarantee of his professional standing, but Dr. Edward H. Rynearson needs no such title to indicate his place in American medicine.

After graduating from the University of Pittsburgh, and taking his interneship at the Mercy Hospital in Pittsburgh, he was, successively, Fellow in Medicine at the University of Minnesota; Mayo Foundation; First Assistant in the Division of Medicine; physician; consultant; and since 1947, head of the Section of Medicine, Mayo Clinic. He is Associate Professor of Medicine in the Mayo Foundation for Medical Education and Research, University of Minnesota.

He is a member of numerous professional societies and has particularly distinguished himself in the field of endocrinology. His contributions to the medical literature on this subject have been outstanding. It is with a great deal of pleasure that I present Dr. Rynearson who will address us on "Is Obesity an Endocrine Problem?"

IS OBESITY AN ENDOCRINE PROBLEM?

EDWARD H. RYNEARSON, M. D.

Consultant, Division of Medicine, Mayo Clinic

Rochester, Minnesota

This subject is controversial and a great many of you may take issue with what I say, because my opinions are strongly biased. The whole thesis of these remarks is based upon the simple facts that the one source of fat is food — and the one treatment for obesity is diet. Obesity cannot be explained on any basis except that of pure caloric intake. It should be said here that certain conditions affecting the brain and brain stem will produce increased appetite, but there is no known lesion which will produce fat from air or water.

The extreme variations of body weight in humans is indeed remarkable. Spectacular degrees of overweight attract the interest of the profession as well as the public at large. Of much greater concern to your group, representing the life insurance industry, and from the standpoint of public health, are the lesser grades of overweight. Obesity is most dangerous in the later half of life, and one authority (1) states that between the ages of 45 and 50 years twenty-five pounds of excess weight results in a twenty-five per cent increase in mortality. Indeed, the mortality increase is relatively in proportion to the degree of weight above that generally accepted as average for the height.

The association of obesity with an increased incidence of early hypertension, heart disease, arteriosclerosis, nephritis, cirrhosis of the liver, diabetes, and other conditions known to shorten the life span, is well known. It seems reasonable to expect that the prevention of obesity or its early correction would greatly diminish the associated incidence of degenerative diseases. One authority states that overweight is least

dangerous under the age of 30 years, and it may be a factor reducing susceptibility of these individuals to pulmonary tuberculosis (2) although this would be difficult to prove. The greatest life expectancy is said to occur in persons who are slightly overweight up to the age of 30 years, of average weight to about age 40 years, and definitely underweight thereafter (3). Surely no one realizes better than you that physicians should be alert to the dangers of overweight and should develop the skill necessary to give their patients sound advice and specific dietary instruction.

Among the etiologic factors are those related to the economic status of populations. The southern Europeans, particularly those in countries where famine has been well known, have elevated the subject of food to the point where it constitutes a badge of success. If one can set a better table in the home than the others, this is recognized as a social distinction and becomes, therefore, a factor in the body weight of the members of the family. In some countries, particularly in Asia, whole populations suffer from undernourishment for years and it is rare to see a fat individual among them.

Some causes for overeating, and also for undereating in the presence of adequate food supplies, are emotional stress, training, and habits. The psychologic pattern of mothers of obese children is as distinctive as that of the children themselves. Such mothers may go to extremes in protecting their children from even minor conflicts of living and, paradoxically, they entertain great ambitions for them. Under such conditions, there is frequently great emphasis on food, and food becomes the means of compensation for good behavior. "If you're a good boy you may have two desserts; if you're bad you'll go to bed without your supper".

In certain households the family may enjoy the attitude and feeling that good food in generous quantities is not only a pleasure but one of the main purposes of life. It is not surprising that the entire family may become obese; and these early impressions may govern the eating habits of the younger members of the family in later life (4). Certainly the neuroses and psychoses play a part in the variations of body

weight. The high incidence of psychologic abnormalities is suggested by the investigations of a number of psychiatrists (5). However, the reason is not always clear why certain conflicts or anxieties may cause polyphagia in one person, anorexia in another, and leave the appetite of a third unaltered (6). The apparent increase in the incidence of neuroses associated with obesity is not well established in most investigations because these do not include psychiatric studies on persons of normal weight as controls.

Some of the portions of the nervous system less well developed than the cortex undoubtedly influence appetite to some degree in a more or less involuntary manner. Animal experiments have demonstrated that destruction of certain nuclei in the posterior portions of the hypothalamus will cause a vastly increased appetite, and the intake of food is limited only by the capacity of the gastrointestinal tract. Consequently obesity develops at once. But if these animals are fed the same amounts of food as the controls the weight remains normal, or if allowed to become fat they lose weight normally on a weight reduction diet (7). These experiments suggest that obesity of the Frohlich type may be the result of a lesion or disturbance affecting the hypothalamus. Unfortunately, the terms "Frohlich's syndrome" and "adiposogenital dystrophy" carry the implication of some fundamental disorder of the endocrine or central nervous systems. A suggested explanation for the clinical appearance of such obese boys is derangement of the hypothalamic function, but there is no convincing evidence of this. For these reasons it is suggested that the terms "Frohlich's syndrome" and "adiposogenital dystrophy" be restricted to obese, sexually immature males who have passed the age of normal puberty and in whom there is additional evidence of a lesion involving the region of the hypothalamus and hypophysis (8).

There are a good many wrong impressions concerning obesity. The opinion that the gastrointestinal tract of the overweight individual absorbs a greater proportion of the food passing through it is erroneous (1). A thin person is said to be thin because his intestinal tract does not absorb

food normally (9). This is untrue. Only occasional patients with definitely recognized syndromes, such as sprue, have a disturbance of bowel function, including inadequate absorption of food elements, to explain their leanness.

Endocrine disorders are rarely if ever the cause of pronounced obesity, although attempts have been made to diagnose many varieties of endocrine aberrations by variations in the distribution of body fat. These variations have little diagnostic significance except in Cushing's syndrome and progressive lipodystrophy. The latter condition is rare and is characterized by the unequal distribution of fat, large masses appearing in some parts of the body, with atrophy of subcutaneous tissue in other parts. Its cause is unknown. Cushing's syndrome is not invariably accompanied by overweight. The syndrome, a rare condition, is found in association with hyperfunction or tumor of the adrenal cortex. For the sake of discussion, I am willing to say that not more than one of a thousand obese individuals has anything wrong with the endocrine glands.

Obesity following the development of islet cell tumors of the pancreas is the result of increased food intake necessary to relieve the symptoms of hypoglycemia. Functional hypoglycemia may result from anxiety under certain conditions, with only a moderate lowering of the blood sugar content and in the absence of an islet cell tumor. In this condition, obesity is not a constant finding but when present represents over-eating.

Hypothyroidism is frequently blamed for obesity, but the evidence for this assumption is not conclusive (10). The basal metabolic rate in obese persons is usually quite within normal limits (11). Dysfunction of the hypophysis of every possible kind and degree, involving all of the three lobes of this gland, has been suggested as a cause for obesity. I have never seen obesity related to a pineal tumor but the possible association of a pineal tumor with obesity would almost certainly be the result of damaged hypothalamic function. In castrated animals, hypogonadism almost invariably causes obesity, but

a similar response to castration or hypogonadism has not been observed in humans. The treatment of obesity with sex hormones has not proved of value.

The effect of inheritance factors in the occurrence of obesity offers a wide range of speculation. While it is true that obesity tends to occur with greater frequency in certain families, it is difficult to hazard a guess as to whether environment or the genes have the greater influence on eating habits (12). Possibly in some persons inheritance is of greater importance, while in the same persons or in others psychologic and environmental influences dominate, depending on circumstances. There is a mistaken idea among patients whose "parents were big people" that their fat is less dangerous to them than fat on persons without the hereditary tendency to obesity. They rationalize that diet will be of little help to them and that weight reduction might indeed constitute a danger to their health.

What are the contraindications to low caloric diets? It is usually considered best to postpone weight reduction in patients with peptic ulcer or pulmonary tuberculosis until these conditions become inactive or arrested. Then diets of 1,200 to 1,500 calories may be prescribed according to the individual needs of the patient. Personally I doubt whether either of these conditions constitutes contraindication.

Let us turn to the question of treatment. The treatment for obesity is entirely one of a diet low in calories, with such psychotherapy as may be necessary to help the patient remain on the diet.

When the amount of weight to be lost is large and when a rapid loss of weight is desirable, diets of 600 calories may be prescribed. The foods should be weighed and the patients trained in this technique. It is surprising how quickly they become accustomed to weighing their food. A less rapid rate of loss is assured with diets of 1,000 to 1,500 calories (13). Such representative diets are shown in Tables 1 and 2. A further variety of reduction diets is available elsewhere (14). These diets should be prepared on scales with a movable face

*TABLE 1
DAY'S ALLOWANCE OF FOOD

1,000 Calory Diet
1. Lean meat, fish, fowl, dry cottage cheese, 150 Gm. (5 oz.), and 1 egg. Must be free from fat, cooked without fat (no gravy)
2. Skim milk or buttermilk, 480 Gm. (1 pint)
3. Bread or plain rolls, 60 Gm. (2-3 slices)
4. Cereal, none
5. Starchy foods such as potato, beans (dried or lima), corn, hominy, macaroni, noodles, rice, spaghetti, none
6. Vegetables (except above), 400 Gm. (2 cups). Canned, cooked, frozen or raw
7. Fruits (see list below), 3 servings including 1 of citrus fruit or juice
8. Desserts, none except saccharin-sweetened gelatin dessert, rennet dessert or custard made with skim milk
9. Sweets, none except saccharin
10. Soups, none except clear broth or soup made from vegetable or skim milk allowance
11. Fat (butter, margarine, mayonnaise or oil), 15 Gm. (1 level tbsp.) and 20% cream, 30 Gm. (2 tbsp.)
12. Miscellaneous (black coffee, clear tea, herbs, lemon juice, salt, spices, vinegar), as desired

Servings of Fruit Allowed on 1,000 Calory Diet

Fresh	Water-Packed Canned
½ apple	½ cup apple sauce
1 apricot	4 halves apricots
½ banana, small	1 cup blackberries
½ cup blackberries	½ cup blueberries
½ cup blueberries	1 cup cherries, red or white
½ cup cranberries	½ cup cherries, black
½ cup currants	½ cup fruit salad
½ grapefruit	½ cup grapefruit juice
½ cup grapefruit juice	½ cup kadota figs
⅛ honeydew melon	1 cup loganberries
½ cup huckleberries	½ cup orange juice
1 lemon	1 cup peaches
2 limes	2 halves pear
1 orange, medium	2 rings pineapple
½ cup orange juice	½ cup pineapple juice
1 peach	2 plums
½ pear	1 cup raspberries
2 rings pineapple	1 cup strawberries
1 plum	½ cup white grapes
½ cup raspberries	
1 cup rhubarb	
½ cup strawberries	
¼ slice watermelon	

*TABLE 2
EXAMPLE OF 1,000 CALORY DIET

Foods Allowed	Sample Menu	1,000 Calory Diet: Wt., Gm.	1,000 Calory Diet: Approximate Measure (Volume)
	BREAKFAST		
Fruit, citrus	Grapefruit	100	½ medium
Cereal	Whole grain cereal	...	.....
Egg	Egg, soft cooked	50	1
Bacon	Bacon	...	.....
Bread	Whole wheat toast	20	1 slice
Butter	Butter	5	1 tsp.
Beverage	Coffee	...	1 cup
Cream, 20%	Cream	30	2 tbsp.
Sugar	Sugar	...	.....
Jelly	Jelly	...	.....
	DINNER		
Soup	Cream of potato soup	...	.....
Meat or substitute	Roast beef	75	2½ oz.
Potato or substitute	Mashed potato, gravy	...	.....
Vegetable	New cabbage	100	½ cup
Salad	Sliced tomato	100	1 medium
Salad dressing	Mayonnaise	...	.....
Fruit (list, table 1)	Sliced orange	100	1 medium
Dessert	Vanilla ice cream	...	.....
Skim milk	Skim milk	240	½ pint.
Milk, ½ cream	Milk, ½ cream	...	.....
Bread	Whole wheat bread	20	1 slice
Butter	Butter	5	1 tsp.
	SUPPER		
Soup	Cream of pea soup	...	.....
Meat or substitute	Cold sliced ham	75	2½ oz.
Potato or substitute	Baked potato, butter	...	.....
Vegetable	Green beans	100	½ cup
Salad	Celery and carrot sticks	100	5-5 sticks
Fruit (list, table 1)	Water-packed pears	100	2 halves
Dessert	Chocolate pudding	...	.....
Skim milk	Skim milk	240	½ pint
Milk, ½ cream	Milk, ½ cream	...	.....
Bread	Bread	20	1 slice
Butter	Butter	5	1 tsp.
Beverage	Tea with lemon	...	1 cup

Approximate Composition of Diets	Unit	1,000 Calory Diet
Protein	Gm.	70
Fat	Gm.	40
Carbohydrate	Gm.	100
Calories	....	1,040
Calcium	Mg.	850
Iron	Mg.	11
Vitamin A	I.U.	6,100
Thiamine	Mg.	1.4
Riboflavin	Mg.	1.7
Niacin	Mg.	11
Ascorbic acid	Mg.	180

*Tables 1 and 2 are reproduced with the permission of the Editor of the Journal of the American Medical Association (see ref. 8)

as designed for weighing the diets of diabetes patients. Unless the food is weighed rather than measured by volume, patients tend to increase the actual caloric intake about 200 or more calories in excess of the prescribed diet.

Careful instruction by the physician impresses the patient with the importance of the diet. Success of such a therapy depends largely on careful instruction of the patient and his knowledge of his diet. Handing the patient a printed diet list without explanation of the many questions which may arise concerning it frequently ends in failure and dissatisfaction. Menus which do not allow considerable choice may be a reason for failure. Patients receive practical instruction in the arrangement and composition of suitable diet lists by actually writing these out for themselves, as they may be influenced by economic, racial and religious preference. No restriction is placed on the intake of certain essential dietary requirements such as salt and water, and diets should be supplemented by one of the multiple vitamin preparations. Especial attention has been given to make certain that the patient receives adequate amounts of protein, calcium and other minerals.

The loss of weight on carefully regulated regimens may occur frequently in a stepwise fashion in which the weight may remain unchanged for periods longer than a week and then show a rapid loss. This may be explained as possible variations in the amount of extracellular fluid present. Restriction of salt may diminish the range of changes observed in this phenomenon, but the final result will not be affected by it. Patients and physicians should not be discouraged by temporary fluid retention.

While it is true that psychologic and psychiatric factors have been emphasized recently in the treatment of obesity, it should be remembered that in many fat patients these are not demonstrable. Thus no formal psychiatric therapy seems necessary. A frank discussion and warning of the dangers to health, with emphasis on a proper diet as the only effective treatment, are imperative. These patients need reassurance that the program will terminate in success and that no harm

to them can occur while they cooperate with the physician. Well meaning friends and relatives should be ignored when they interfere with treatment for any reason, whether intentional or unintentional. The patient should be warned that there is no easy road or half measure which will replace his diligent adherence to the dietary instructions.

Drug therapy has been suggested in conjunction with dietary help. While amphetamine sulfate ("benzedrine sulfate") and its dextrorotatory isomer ("dexedrine") will diminish appetite (15), these affect obesity if at all simply by the reduction of food intake. Some patients continue to eat excessively in spite of such drugs. Amphetamine has certain undesirable side effects when given in single large doses or when administered at irregular intervals (16). Smaller doses which would be associated with minimal circulatory effects should adequately reduce the appetite if the drug is to be effective at all. Medicines of this type may be unwisely substituted by patients for strict adherence to a diet, and being anxious to lose weight the patient may select a diet inadequate in such essentials as protein and calcium. It is rarely necessary to use such drugs, because the appetite usually diminishes during the first week of dietary restriction. While many physicians believe these drugs may be useful I wish to emphasize that proper emphasis must be placed on diet in the therapy of obesity.

The use of thyroid extract in the treatment of obesity is not justified. Obesity and hypothyroidism have only a casual relationship. From early investigations it was erroneously assumed that hypothyroidism was frequently associated with overweight. Thus the use of desiccated thyroid seemed logical. Some physicians have deliberately created a state of hyperthyroidism with large doses of thyroid, but such a practice is not advisable. The dangers from the toxic effects of this drug on the cardiovascular system are well known. Small doses of thyroid are ineffective (17), while the toxic doses (18) may seriously impair a heart already overburdened by obesity (18).

Newburgh estimated that a patient must walk 36 miles (58 km.) to lose one pound of fatty tissue. Exercise, as well as massage and local applications of heat have been demonstrated to have no effect on local deposits of fat (19). Likewise, laxatives and colonic irrigations do not affect the absorption power of the intestinal tract for food. A variety of other measures, including such drugs as atropine and digitalis with various endocrine products, have been used in the treatment of obesity, without benefit. Dinitrophenol is contraindicated because if its toxicity.

SUMMARY

Overweight is a serious health impairment because it appears to be directly associated with the incidence of many degenerative diseases. A weight reduction program is essential in the prevention of such diseases. The cause of obesity is a disproportion between the caloric requirement and the caloric intake.

Psychotherapy is frequently an important adjuvant to dietotherapy. The administration of amphetamine in certain cases has been discussed. Desiccated thyroid, digitalis, diuretics and atropine are of little use in certain reduction programs. Likewise, exercises and massage are ineffective but exercise will dispose of excessive energy from overeating.

REFERENCES

1. Newburgh, L. H.: Obesity, Arch. Int. Med. **70:** 1033-1096 (Dec.) 1942.
2. Dublin, L. I.: Influence of Weight on Certain Causes of Death, Human Biol. **2:** 159-184 (May) 1930.
3. Girth and Death, Statist. Bull. Metrop. Life Ins. Co. **18:** 2-5 (May) 1937.
4. Bruch, H. and Touraine, G.: Obesity in Childhood; Family Frame of Obese Children, Psychosom. Med. **2:** 141-206 (April) 1940.
5. Bruch and Touraine. Freed, S. C.: Psychic Factors in the Development and Treatment of Obesity, J. A. M. A. **133:** 369-373 (Feb. 8) 1947. Rahman, L., Richardson, H. B. and Ripley, H. S.: Anorexia Nervosa with Psychiatric Observations, Psychosom. Med. **1:** 335-365 (July) 1939.
6. Johnson, W. M.: Different Weight Responses to the Same Provocation, J. A. M. A. **133:** 1238 (April 19) 1947.

7. Brobeck, J. R.: Mechanism of the Development of Obesity in Animals with Hypothalamic Lesions, Physiol. Rev. **26:** 541-559 (Oct.) 1946. Heinbecker, P., White, H. L. and Rolf, D.: Experimental Obesity in Dog, Am. J. Physiol. **141:** 549-565 (June) 1944. Hetherington, A. W.: The Production of Hypothalamic Obesity in Rats Already Displaying Chronic Hypopituitarism, ibid. **140:** 89-92 (Oct.) 1943.
8. Gastineau, Clifford F., Rynearson, Edward H. and Irmish, Alice Karslake: Treatment of the Fat and the Lean, J. A. M. A. **139:** 86 (Jan. 8) 1949.
9. Strang, J. M. and Evans, F. A.: Undernutrition and Its Treatment by Adequate Diet, Ann. Int. Med. **7:** 45-63 (July) 1933. Strang, J. M. and Cox, A. B.: The Analysis of High Caloric Diets in Relation to Weight Changes, ibid. **7:** 152-164 (Aug.) 1933. Small, S. M. and Milhorat, A. T.: Anorexia Nervosa: Metabolism and Its Relation to Psychopathologic Reactions, Am. J. Psychiat, **100:** 681-685 (March) 1944.
10. Plummer, W. A.: Body Weight in Spontaneous Myxedema, Tr. Am. A. Study Goiter, 1940, pp. 88-98.
11. Boothby, W. M. and Sandiford, I.: Summary of the Basal Metabolism Data on 8,614 Subjects with Especial Reference to the Normal Standards for the Estimation of the Basal Metabolic Rate, J. Biol. Chem. **54:** 783-803 (Dec.) 1922.
12. Gurney, R.: The Hereditary Factor in Obesity, Arch. Int. Med. **57:** 557-561 (March) 1936.
13. Footnote on Tables 1 and 2.
14. Rynearson, E. H. and Gastineau, C. F.: Obesity, Springfield, Ill., Charles C. Thomas, 1948.
15. Harris, S. C., Ivy, A. C. and Searle, L.: The Mechanism of Amphetamine-Induced Loss of Weight: A Consideration of the Theory of Hunger and Appetite, J. A. M. A. **134:** 1468-1475 (Aug. 23) 1947.
16. Beyer, K. H.: The Effect of Benzedrine Sulfate (Beta-Phenylisopropylamine) on Metabolism and the Cardiovascular System in Man, J. Pharmacol. & Exper. Therap. **66:** 318-325 (July) 1939.
17. Winkler, A. W., Lavieties, P. H., Robbins, C. L. and Man, E. B.: Tolerance to Oral Thyroid and Reaction to Intravenous Thyroxine in Subjects Without Myxedema, J. Clin. Investigation **22:** 535-544 (July) 1943.
18. Rasmussen, H.: Influence of the Thyroid Hormone on Heart and Circulation, Acta Med. Scandinav. (supp.) **115:** 1-202, 1941.
19. Short, J. J. and De Paul, J.: An Attempt to Mobilize Lipoids from Storage Depots by Deep Massage and Increased Tissue Temperatures, J. Lab. & Clin. Med. **24:** 395-397 (Jan.) 1939.

PRESIDENT UNGERLEIDER — Dr. Rynearson's excellent presentation is now open for discussion. This question of obesity is one that we have every day in our work, and I am hoping somebody will discuss it from the angle of mortality.

DR. ARTHUR J. MCGANITY — I am not going to criticize the paper or discuss it at all. I should like to ask Dr. Rynearson how strictly he follows these 625-calorie diets, and for what

period of time? How long would you expect a man whose excess was probably 30 or 40 pounds — how long would you expect him to take to reduce if he has had one coronary infarction, or perhaps two?

DR. RYNEARSON — I recognize no contraindications for the rigid reduction diet. There is possibly one and that is pulmonary tuberculosis. I should like to have my friends who treat this disease tell me whether they really think having the patient fat is of any help in the healing of tuberculosis? That point has not been settled. But I am sure that obesity is bad for coronary sclerosis. I have never heard of a patient with a recent or healed coronary infarct being injured by putting him on a rigid reduction diet. Although I am quite well aware of the fact that there is nothing to suggest that obesity caused the coronary thrombosis, we do believe the evidence favors it. In summary we put these patients right on the rigid diet if they need it, and they can follow it just as well as anyone else. In our experience they have not had an unhappy result with it.

PRESIDENT UNGERLEIDER — Any other questions or discussion?

DR. WILLIAM B. THORNTON — I should like to ask Dr. Rynearson what those of us who are also in practice are to do with people who have not the will power to follow these strict diets. It is all very well for the Mayo Clinic to say "We are not interested and will not be bothered with you." But surely we, as practicing physicians, have a responsibility to the public, and surely obesity is a serious enough problem to make us do more than just dismiss the patient who is not personally interested or capable emotionally, or mentally, of following these strict regimens.

PRESIDENT UNGERLEIDER — While you are about that, Dr. Rynearson, I should like to ask you a question and you can answer them both together. Do you prescribe this very strict 625-calorie diet for an ordinary individual who is 15, 20, or 25 pounds overweight who wants to reduce to normal weight, the reason being for cosmetic or other reasons?

DR. RYNEARSON — I will answer the second question by saying no. A great many people will lose on 1,600 calories a day. A tremendous number of patients are given 1,000-calorie diets, and for the most part we leave it to the patient, saying, "Are you enough interested in this, and is it an acute enough problem for you to spend one week with this diet, learning to weigh all of the food, learning how to manage your program scientifically?" If a patient weighs 400 or 500 pounds, for example, it doesn't make sense to suggest a 1,500-calorie diet. It would take too long to lose 200 pounds. But on the rigid diet the patient can see he's getting somewhere.

In answer to the first question, I should be interested to know what the doctor does about his other patients who will not follow his advice. What does he do with patients who have a duodenal ulcer, and he prescribes a regimen which they ignore? What does he do with patients with coronary artery disease for whom he outlines a program and who reject his advice? What do any of you do with any of your patients who have not enough confidence in you, or who are not honest enough to want to follow your advice?

I have nothing to offer them but diet. I have got to tell them the truth. If they have the will power, they will follow it. If they have not, they will go right down hill and enjoy their ill health, or suffer from it, until some other disease takes them off.

But I will say that whether I was with the Mayo Clinic or in private practice, once I had given the patient the best advice of which I was capable I would have fulfilled my responsibility as a physician and as a friend. If he rejected my advice, I would let him go to somebody else and spend my time on the next patient who might have enough confidence to listen to what I had to say and might follow my advice.

DR. UNGERLEIDER — We shall now have a paper by our well known member, Dr. Hugh B. Campbell of the Phoenix Mutual Life Insurance Company. The subject to be discussed by Dr. Campbell is "Sarcoidosis and Histoplasmosis".

SARCOIDOSIS AND HISTOPLASMOSIS

HUGH P. CAMPBELL, M. D.

Medical Consultant

Phoenix Mutual Life Insurance Company

Hartford, Connecticut

HISTOPLASMOSIS

Pulmonary calcifications have long been a source of conjecture and argument. In the earlier days of roentgenology and even in the later ones, until the development of case finding programs, they were assumed to represent foci of healed tuberculosis. Not infrequently, correctly or otherwise, instances of healed miliary tuberculosis were cited with a chest film showing calcium deposits as the confirmatory evidence.

When Long and Stearns (1), as a result of a survey of 53,400 induction films of prospective members of the U. S. Army in World War II, revealed the high incidence of pulmonary calcifications and the low morbidity and mortality rates in tuberculosis in the areas from which many of these examined came, a curiosity was aroused which resulted in a new and intriguing field of investigation.

The Army roentgenological survey showed a variation of calcific deposits, ranging from 6 per cent in examinees in Oregon to 28 per cent in Kentucky. The greatest prevalence occurred in prospective inductees from Kentucky, Arkansas, Illinois, Indiana, Iowa, Maryland, Mississippi, Missouri, North Carolina, Ohio, Tennessee, Virginia and West Virginia. This area, it will be noted, represents in general the central eastern states in the Mississippi Valley, or areas adjacent to it.

Assuming the calcifications represented an earlier tuberculous infection, many with such findings were rejected for Army service.

Carroll E. Palmer (2), in 1945 cited a number of investigators reporting negative tuberculin reactions in persons with calcifications, and the result was a stimulation to research to find if possible a non-tuberculous origin for the condition.

Smith (3), stated in 1943 that a high incidence of pulmonary calcifications, with negative tuberculin reactions, was found in the areas where histoplasmosis was endemic. Christie (4), in his work in Tennessee, came to the conclusion that histoplasmosis or some closely related infection was the responsible factor.

Aronson, et al (6), was able on the basis of skin tests in Indians in the southwest to show that coccidioidomycosis produced calcium deposits. Smith (3), reported the same findings and furnished material for coccidioidin tests for use in a sample group of student nurses in Detroit, Kansas City, Philadelphia, and Baltimore. The findings were essentially negative. In the group only a few showed a positive reaction, the majority of whom gave a history of living or travelling in the southwest or in California.

Christie and Peterson (4), tested 125 children in Tennessee with coccidioidin with no significant reaction and came to the conclusion that coccidioidomycosis is neither a clinical nor pathological problem in Tennessee. They made the further observation that coccidioides immitus is a fungus of dry or arid regions, differing from the regions in the central eastern states.

When the possibility of coccidioidomycosis was eliminated as a factor in the middle west, more intensive research developed on histoplasmosis.

Histoplasmosis is a disease essentially affecting the reticuloendothelial cells. In 1945, Christie stated that it occurs in all age groups and from all reports is uniformly fatal. Later investigations tend to support the belief that it also occurs in a benign widespread form and is productive of many of the pulmonary calcifications seen.

David T. Smith (5), says that histoplasmosis was not proved to be a mycosis until about 1934. The etiologic agent is Histoplasma capsulatum, a small budding yeast-like cell which can be cultured on common laboratory media. The infection is productive of lesions simulating many diseases and may be accompanied with ulcer, miliary lesions with caseous necrosis and granulomata. Because of these latter manifestations, Christie thinks it is possible to assume that benign forms may exist with a picture similar to that in coccidioidomycosis with a primary complex going on to calcification.

An investigation on tuberculosis in student nurses about 1944 (2), provided the opportunity to study also the problem of pulmonary calcium deposits in individuals having negative tuberculin reactions. The National Tuberculosis Association, the United States Public Health Service and a group of tuberculosis specialists conducted an investigation on approximately 10,000 student nurses in 65 nursing schools in 9 cities throughout the country. Tuberculin tests were made and chest films taken every six months. For the tuberculin tests PPD 5 (purified protein derivative) was used, and the histoplasmin was obtained from the National Institute of Health.

The tests were intradermal; 0.0001 mg. in 0.1 cc of tuberculin and 0.1 cc of a 1/1000 dilution of filtrate of broth culture of Histoplasma capsulatum were used.

It was the opinion of the investigators that reactions of tuberculin and histoplasmin are similar and not to be distinguished by appearance. For standardization, positive reactions were those having a diameter induration of 5 mm. or more.

In April 1949, a personal inquiry concerning testing materials and methods from Dr. Herbert L. Mantz of Kansas City, Missouri, recently President of the National Tuberculosis Association, who has been active in clinical research in histoplasmosis, made available the following information.

"I doubt if the histoplasmin test is a routine procedure. Many of the chest men do it, but I feel sure that the general men do not . . . . . We secure our material from the United States Public Health Service but this source cannot be used by physicians in general. Eli Lilly & Co. are now making test material and I have secured some from them, but have not really compared it with the material we are using, so I do not know how reliable it is. If they put it on the market it should be cheaper than the tuberculin test. The material seems to be very stable and 1 cc of concentrate will make up a liter one to one thousand, which is the strength we use."

Palmer (2), reporting on the study of the nursing group in 1945 showed that of 3,105 nurses studied, 711 (22.9 per cent) showed a positive reaction and 61 (2 per cent) a doubtful reaction to histoplasmin. Though allowance must be made for non-residents taking training in states to which they were not native, nevertheless the varied prevalence was most interesting. Kansas City was outstanding. The findings there and in 4 other cities are appended herewith (5a).

The figures just cited refer to reactors to histoplasmin. In the total group of nurses examined, 3,105, 294 showed pulmonary calcifications. The tuberculin and histoplasmin reactions in that group showed:

	Cases	%
Tuberculin positive, histoplasmin positive	35	11.9
Tuberculin positive, histoplasmin doubtful	8	2.7
Tuberculin positive, histoplasmin negative	20	6.8
subtotal (all tuberculin positive)	63	21.4
Tuberculin negative, histoplasmin positive	198	67.4
Tuberculin negative, histoplasmin doubtful	8	2.7
Tuberculin negative, histoplasmin negative	25	8.5
subtotal (all tuberculin negative)	231	78.6

The result of a most interesting study was recently reported by Prior-Wilce and Palchanis (7). Four thousand eight hundred and twenty-nine students entering the Ohio State University in the fall quarters of 1946 and 1948 had histo-

plasmin and tuberculin skin tests and chest films. Those included in the study had been lifetime residents of their respective counties (could not have lived outside of their counties more than four years). There were 3,844 males and 985 females; 640 were farm residents; 4,189 lived in non-farm areas. Skin tests consisted of the intradermal injection of 0.1 cc histoplasmin (H15) in 1/1000 dilution and 0.1 cc of tuberculin PPD containing 0.0001 mg.; and 5 mm. of induration at 48 hours was considered to be a positive reaction. The average positive reaction for the state was 48.8 per cent.

NUMBER AND PERCENTAGE OF HISTOPLASMIN REACTORS AMONG STUDENT NURSES IN SPECIFIED CITIES

	Percentage Distribution Histoplasmin Reactors				No. Persons Histoplasmin Reactors			
	Pos.	Doubt.	Neg.	Total	Pos.	Doubt.	Neg.	Total
Detroit	13.8	0.6	85.7	100	74	3	461	538
Minneapolis	4.7	1.6	93.6	100	46	16	909	971
Kansas City, Mo.	61.5	4.3	34.2	100	397	28	221	646
Kansas City, Kan.	50.2	3.8	46.0	100	107	8	98	213
Philadelphia	11.8	.8	87.4	100	87	6	644	737
	22.9	2.0	75.1	100	711	61	2333	3105

The prevalence in male students was 49.6 per cent and among female students 45.6 per cent. Among students from farms the reactors were 60.6 per cent as compared with a non-farm resident of 47 per cent.

The tuberculin reaction did not follow a similar pattern. The industrial areas were highest, and the lowest were in the farming sections.

The highest incidence of pulmonary calcification is in the southwest, 20.1 per cent, decreasing to the northeast with a percentage of 5.6.

The conclusion of the authors is that most pulmonary calcifications in Ohio and other middle western states are probably the result of a benign widespread form of histoplasmosis or an antigenically related agent or agents.

Of the fatal form of the disease, until January, 1945 only 74 cases had been reported. In 1948, Bunnell and Furculow (8) published an article on 10 proved cases of histoplasmosis, and in Public Health Report of August 4, 1950, Furculow discussed six cases studied in the Kansas City area. Of this latter group, five were in the previously reported group of 1948. These two studies present an opportunity for the discussion of the clinical manifestations of histoplasmosis.

Of the 10 patients, four were juveniles, having ages of 13 years, 5 months, 20 months and 6 months. The others were adults, having ages of 52 years, 64 years, 26 years, 48 years, 53 years, and 37 years. The oldest in the juvenile group, a boy of 13 years, in 1945 reported malaise and headaches for 3 months previous to hospital admission. X-ray of the chest showed miliary lesions in both lung fields, with bilateral enlargement of hilar lymph nodes. Sedimentation rate (Cutler) was 25 and 29 mm. at the hour. Other laboratory tests were essentially negative. Tuberculin test was negative. Histoplasmin was positive in November, 1945. In June, 1949, 4 years later, the soft infiltrations previously noted had become calcifications, scattered throughout both lung fields and in the hilar nodes. The boy is now in good health.

The 5-month male and 20-month female were seen first in March, 1947. Both had fever, hepatomegaly and splenomegaly. The 20-month old female also had abdominal distention. Chest x-rays of the younger child at no time showed abnormal chest shadows. In the older child an infiltration in the right base and right hilar adenopathy were observed. Histoplasma capsulatum was present in the blood and sternal marrow of the younger child, and in the spleen which was removed from the older child. Both children are now well and free of symptoms. Calcification is present in the affected areas in the right chest of the older child. The fourth child, a female 6 months old, came from a farm 100 miles east of Kansas City, Missouri, and was first seen in October, 1947. In her clinical picture, she presented fever, hepatomegaly, splenomegaly, anemia, leukopenia and thrombocytopenia. Tenderness was marked over the abdomen, accentuated on movement of the legs.

X-ray of the chest showed hilar involvement and infiltration of the right lower lobe. On the 9th day of hospitalization, tuberculin and histoplasmin tests were negative, but organisms were seen in bone marrow smears made on the 10th day. On the 14th hospital day she died. Autopsy showed Histoplasma capsulatum present in the liver, spleen, adrenals, kidneys, and lungs, and ulceration of the intestinal mucosa.

In the adult group, a 52 year old farmer and a 64 year old male clerk were among the group reported in 1948. Loss of weight and cough were symptoms in both. Neither presented signs of enlargement of liver or spleen. One had diarrhea. Negative tuberculin but positive histoplasmin reactions were obtained in the 52 year old and positive tuberculin and positive histoplasmin reactions were found in the 64 year old. The farmer showed infiltration throughout the left lung and upper lobe of the right lung. Bronchograms revealed bilateral cylindrical bronchiectasis. Physical examination of the clerk included findings of axillary nodes and cavity formation in the upper lobe of the right lung. These were the findings in 1948. When observed in April, 1950, the 52 year old farmer had undergone marked loss of weight, gave a history of so called "attacks of influenza" characterized by fever of 102 - 103 F., cough and marked expectoration. Repeated sputum and guinea pig inoculations were negative for tuberculosis, but 11 out of 16 sputum examinations were positive for Histoplasma capsulatum. Chest film shows progressive increase of disease in both lungs with cavitation.

The 64 year old clerk, who had a positive tuberculin and positive histoplasmin test in 1947, returned to the hospital in April, 1949, for a course of bacillomycin (Wyeth). At that time he had cavitation in the right lung, fibrocalcific lesions in the left, and emphysema. Following the development of severe cellulitis, bacillomycin was discontinued and sulfathiazine therapy instituted. He seemed to improve but developed convulsive seizures on May 1, 1949, and died. Autopsy revealed histoplasmosis of the lungs, adrenals, and spleen. There was no evidence of tuberculosis.

As a result of investigations over the past few years, more of the severe cases are now diagnosed, while hospitalized, by biopsy and culture or by cultures from the blood or sternal bone marrow.

Laboratory studies on sputum may show the presence of the small oval yeast-like cells.

Where lymphadenopathy is evident, Hodgkin's disease and lymphosarcoma have been suspected and must be considered in differential diagnosis. In pulmonary cases, the usual procedure has been admission to a sanatorium under a diagnosis of tuberculosis, the physical findings being similar.

Treatment

The sulfanomides, penicillin and streptomycin, have been used more recently without beneficial results. Earlier, iodides, radiation, bone and liver extracts and the arsenicals also proved ineffective.

There seems to be sufficient evidence to agree with the statements of many that this disease exists in two forms — a severe or malignant type and a benign form. The former is fatal; the latter without subsequent significance.

SARCOIDOSIS

Sarcoidosis has been defined as a chronic granulomatous disease, characterized pathologically by small epithelioid tubercle-like lesions occurring in any organ or tissue, and clinically by a chronic course with few if any symptoms unless the lesions involve vital structures. As described by Pinner (1), histologically the lesions consist of tuberculoid accumulations of epithelioid cells frequently, but not always, surrounded by a layer of lymphocytes. Within the epithelioid follicles occasional cells of the Langhans type are seen. Necrosis and caseation are absent (this observation has since been modified), although single epithelioid cells may show some slight necrobiotic changes; exudative features and polymorphonuclear cells are absent. This description does not include the earliest phases nor the late phases, since clinical and roentgenologic observations demand the inclusion of resorption and fibrosis.

The systemic nature of the disease was not recognized fully until within the last 15 years. For many years prior to 1936, individual lesions affecting many parts or organs of the body were reported and described by many clinicians. Hutchinson (2) reported the condition occurred in a patient in 1869. The part affected was the forefinger, and brawny edematous swelling was the outstanding feature. Besnier (3) in 1889 reported a patient with violaceous swellings of the nose, ears and joints of the fingers. He noted the absence of ulceration, the enlargement of cubital lymph nodes, and longitudinal striations of the fingernails. Lupus Pernio was the name he applied. Hutchinson reported another case in 1898 and called the condition "Mortimer's Malady" after the patient affected.

A similar case to that of Hutchinson was reported in 1899 by Boeck (4). The afflicted individual has lesions of the skin and extensive involvement of the cubital, femoral and axillary lymph nodes. Since the histological changes in the skin, as he viewed them, resembled sarcoma, he called the condition "Multiple Benign Sarcoid of the Skin". In subsequent studies, he reported involvement of lymph nodes, mucous membranes, internal organs, and bones. He believed it to be related to tuberculosis and gave to it the name "Benign Miliary Lupoid".

Kienbock (5) in 1902 gave the first description of radiologic changes in the bones of the hands and feet of an affected patient. He associated it with the skin condition and included the patient in a series of cases of syphilis of the bone. Further contributions from x-ray studies were made by Jungling (6) in 1919. As a result of his early investigations he was convinced that the process was a tuberculous one and gave to the disease the name of "Osteitis Tuberculosa Multiplex Cystoidies". His later studies described the radiologic changes in the bones, including the observations that the medullary portion was affected and the periostium and joints were spared. Histological studies confirmed his belief that this was a form of tuberculosis.

Probably the first reference to pulmonary involvement was that of Kuznitsky and Bittorf (7) in which they described

involvement of the lung roots with definitely large shadows extending into the lung parenchyma. Affected also in the case reported by them were the lymph nodes, liver, and spleen. This generalized disease they reported as of unknown etiology.

Interest in the subject was markedly stimulated in 1934 at the Reunion Dermatologique at Strasbourg where one entire session was devoted to the subject of Sarcoid, and clinical features, pathology, bone lesions, and etiology were discussed.

Since 1935, among the many publishing reviews on the subject of sarcoidosis have been Reisner (8), Longcope (9), Pinner (1), Rubin (10), Snapper (11), Moyer and Ackerman (12), Freiman (13) and as recently as September, 1950, in that month's issue of the American Review of Tuberculosis a report on 50 cases by Riley (14). Most reviewers give extensive bibliographies.

Concerning the multiplicity of names applied to the condition, Riley comments on the confusion developed thereby and joins with others in favoring the name "sarcoidosis" originally used by Boeck because of the fancied resemblance of the epithelioid cellular response to sarcomatous cells.

The disease has been fairly common in the Scandinavian Countries, as well as in France, Germany, Australia, Japan, and Latin America. Within the past seven or eight years, numerous cases have been reported in American medical journals.

In Reisner's (8) series of 35 patients in New York City Hospitals, 30 were negroes and 5 were whites. The author notes that in other groups studied in the United States, there was a preponderance of negroes affected. He believed that to be coincidental. In Riley's (14) most recent article, he states that at the present time it is agreed that the disease occurs most frequently in the negro race, with a higher incidence among females than males.

The Army Institute of Pathology, at the conference on sarcoidosis held in February, 1948, reported that on the basis of material gathered during the war, negro soldiers showed

six times as many cases as did whites. The higher incidence in females was corroborated.

There seems to be general agreement that the disease occurs chiefly in young adults. In Kissmeyer's (15) study of 200 patients, more than one-half the number were affected before the age of 30, and in Reisner's group (8) 21 were between 20 and 29, 7 between 30 and 39, and only 2 were over 40 years of age. Five were between the ages of 8 and 16 years.

Reisner (8) again notes that though sarcoidosis is a systemic disease, it does not always manifest itself with widespread dissemination. Skin lesions are not always accompanied by lymphatic involvement, and cases with complete general involvement are rare. Lymph nodes and pulmonary involvement present the most frequent combination.

Distribution of involvement in Reisner's (8) 35 cases was as follows:

Lymph nodes peripheral	35 cases
Lymph nodes intrathoracic	30
Lungs	30
Skin	14
Bones	9
Spleen	8
Liver	6
Eyes	7
Mucous membranes	4
Parotid gland	4
Lachrymal gland	2
Heart	2
Nervous system	2
Serous membrane	2
Breast	2

As a result of the study of the pulmonary group, Reisner believes that the roentgenologic pulmonary pattern falls into one of three classifications.

The pulmonary lesions may appear as strand-like densities radiating out in a fan shape fashion from both hilar areas and accompanied by massive hilar adenopathy.

They may exist as diffuse widely disseminated bilateral nodular foci evenly distributed in both lung fields. The nodules are frequently larger and coarser than the lesions of true miliary tuberculosis. In this group the mediastinal adenopathy is not so marked and may be obscured by overlying pulmonary disease.

The third group shows a pattern of a combination of the first two.

The opinion is expressed that the patterns are of a transitional nature representing stages of the disease.

Riley (14) as a result of the roentgenologic findings in his series of 52 cases does not believe he can agree with Reisner's opinion, nor does he agree that the nodular type of infiltration represents the early stages of the lesion, except that it may be a preliminary stage to pulmonary tuberculosis or irreversible fibrosis. In one case cited in the early stages, symmetrical areas of fibrosis were localized to both upper lung fields and with progressive disease in a few years preserved that pattern in extending throughout the remaining lung areas.

Snapper (11) states the chest x-rays show a generalized dissemination of sarcoids with preference for the periadventitial layers of the pulmonary capillaries situated in the interalveolar septa. Similar x-ray pictures may be found in miliary carcinosis, silicosis, and anthracosis, in disseminated pneumonia, in Hodgkin's disease, and beryllium poisoning.

Snapper (11) also stresses the fact that sarcoid situated in the interalveolar septa undergoing fibrous degeneration will develop widespread fibrosis with obliteration of the interalveolar capillaries. Resistance in the lesser circulation increases — the right heart is overburdened — and the patient may die of cor pulmonale.

Over the years, controversial discussion of sarcoidosis has centered about its etiology, with the tubercle bacillus in the

center of the controversy. Chief among the proponents of some form of tubercle bacillus as the causative factor is Max Pinner (1). Admitting the difficulty of bacteriologic proof, the rare finding of the organism in the lesion, he suggests that only in the initial phase are tubercle bacilli present, and the immunologic situations which determine the morphologic characteristics of the lesion are the probable cause for the death of the organism. He suggests that sarcoid tubercle is the extreme representative of the productive reaction in tuberculosis, and the greater the productive reaction, the greater the difficulty of demonstration of the bacillus.

As a further argument for tuberculous etiology, he cites the similarity in the morphologic nature of the lesions, each having in one phase a histologically globular arrangement of epithelioid cells, Langhans giant cells, and fibrosis and resorption.

The frequent development or association of sarcoid with progressive caseating tuberculosis is quoted as further evidence of tuberculous origin. Several autopsied cases are cited in substantiation.

The negative reactions to tuberculin are explained as indicating a lack of sensitiveness in line with Jadassohn's theory of anergy.

Reisner (8) reported that in his group of 35 cases, seven died. Five of these showed conclusive evidence of frank tuberculosis sufficiently severe to be regarded as the cause of death. In his opinion, there is a close relationship between sarcoidosis and tuberculosis, and a transition from the former into the latter is a definite possibility.

Riley (14) in citing arguments against the tuberculous etiology mentions the failure to find tubercle bacilli either by culture or animal inoculation in biopsy or autopsy material in an overwhelming number of cases and suggests a possibility of laboratory error in the relatively small group from whom tubercle bacilli have been obtained. He further states that it has been impossible to cause tuberculosis in experimental animals from sarcoid emulsions. In his opinion,

the contention is highly theoretical that in sarcoidosis the tubercle bacillus is a filterable form or has changed its cultural characteristics. In cases dying of tuberculosis one cannot overlook the possibility of a superimposed infection.

The present status of the cause is well summarized by Riley (14) when he states, "The etiology of sarcoidosis at the present is unknown. One cannot deny that there is some relationship, as yet incompletely defined between this disease and tuberculosis. It is doubtful if further clinical studies will aid in clarifying the etiology, but investigations should be directed toward studies which may elucidate the problem of allergy and resistance to the tubercle bacillus in this group of patients."

Symptoms

All who review the subject comment on the paucity of symptoms, even with extensive dissemination of the disease. Especially is that so in cases with pulmonary manifestations. Cough and dyspnoea, if existing, may be mild. With a spread of the process there may be loss of weight, malaise, low-grade fever, loss of appetite and joint pains, but too frequently not severe enough to give the patient much concern. Expectoration is not a characteristic symptom. With progress of the disease and increasing fibrosis, dyspnoea will probably become increasingly annoying.

Reisner (8) says that the chronic stationary phase of the disease is sometimes preceded by a more acute or subacute period usually of short duration. During that stage, one may find constitutional symptoms and signs suggestive of a low-grade systemic infection, such as fatigue, loss of weight, joint pains and subfebrile temperature. It is probable that this period corresponds with the phase of active dissemination of the disease. These symptoms usually subside after a period of several weeks to a few months as the case enters the chronic stage, and the lesions in the various organs may either remain stationary or show marked regression.

In laboratory studies, one fairly consistent finding is elevation of the serum globulin with a normal serum albumin. Cer-

tainly, there are no symptoms characteristic of the disease alone.

Biopsy or bone marrow studies are necessary for diagnosis.

Treatment

Since the cause is unknown, it is not strange that effective therapy is as yet unknown. In the Journal of the American Medical Association (May 27, 1950) the following statement appears under Queries and Minor Notes.

"The cause of Boeck-Baumann-Besnier sarcoidosis is still unknown, and no definite or generally effective mode of therapy has been recorded. Since almost any organ or system may become involved with sarcoidosis, treatment when such is elected is directed against symptoms. Some of the agents which have been employed include arsenic, bismuth and gold compounds, tuberculin, chaulmoogra oil, roentgen rays, radium and ultraviolet rays. Recently, favorable reports have been rendered concerning the use of calciferol and dihydrotachysterol in cases in which the skin lesions have been the main manifestation. However, toxic side effects may occur which are related apparently to elevation of the serum calcium and non-protein nitrogen levels, and the symptoms may be nausea, vomiting, weakness, malaise and dizziness.

"In a recent report from the Conference of Sarcoidosis, held under the auspices of the National Research Council, it is stated that in the natural evolution of the disease 'the outcome may be clinical recovery without gross or radiologically visible residuals, or it may be impairment of function of organs involved, or a continuous chronic course of the disease ....' In several recorded series of cases in which treatment was not given, in about one-third the disease remained stationary or had alternate progression or regression and in one-third it progressed to lethal outcome. Nitrogen mustard has been used in the treatment of four patients with sarcoidosis with some suggestion of therapeutic value. It would seem questionable, however, to employ such a potentially toxic drug in diseases other than malignant lymphatic tumors."

In the Journal of the American Medical Association of July 8, 1950, the opinion stated is, "There is no conclusive proof as yet that streptomycin and dihydrostreptomycin will have any favorable effect on sarcoidosis. The few patients treated have shown equivocal results. It is possible that the few favorable results were obtained in the acute stages of the disease, whereas the negative results were obtained in the fibroid types after fibrosis was well advanced." These opinions conform with those of other authorities quoted.

From his studies and review of the literature, the course and prognosis of this disease is summarized by Freiman (13) and reported by him as follows, "Sarcoidosis tends to run a prolonged low-grade chronic and unpredictable course ranging in duration from several months to many years. Occasionally the onset is abrupt and febrile, and a case is reported in which such an acute onset occurred 36 hours after childbirth. Often, however, it is exceedingly difficult to determine the exact time of onset so that estimates of average duration are not too reliable; these have varied in different series from two and two-tenths to eight or more years. In some series individual cases have been followed for fifteen years or more. Residual lesions were found at autopsy in one of Boeck's early cases twenty-nine years after the original diagnosis had been made, and another case was followed clinically for thirty-four years. The benignity of the course and the generally good prognosis have been repeatedly stressed, and it is certain that a considerable number of patients recover completely. In a group of 37 cases reported by King, approximately half of which were confirmed by biopsy, 23 cleared completely or almost completely within three years, 8 showed no change in periods up to 4 years and the remaining 3 showed extension. On the other hand, in the series of 28 cases followed by Reisner for an average period of five years, all confirmed by biopsy, regression of lesions to the point of disappearance occurred only in a third. In an additional third the disease was essentially stationary or consisted of alternate periods of progression and regression. In the final third, the disease was progressive to the point of death in seven cases, five of which were from tuberculosis.

In Thomas' series of 15 cases, the results were approximately the same. It is possible that a great many of the published cases have been followed for an insufficient period so that the general excellence of the outlook may have been overemphasized. The high incidence of negroes in the series of Reisner and Thomas (86 and 80 per cent respectively) may have had some bearing on the course of these cases, and sarcoidosis in the negro may in fact represent a special problem.

Death is usually due to pulmonary fibrosis with resultant respiratory and cardiac insufficiency, or to superimposed caseating tuberculosis. Extensive localization in vital areas such as the heart and perhaps the kidney and brain may also be fatal in some cases. Other serious complications include glaucoma and phthisis bulba resulting from ocular involvement and the occasional mutilating effects of bone and skin lesions."

Riley (14) believes the benignity of the disease has been overemphasized, and Reisner (8) points out that a stationary behavoir of the lesion even though it may have extended for a period of years does not necessarily permit conclusions as to the ultimate fate of the disease.

It is a disease in which the cause is unknown — the symptoms are not characteristic and not constant — the treatment to date is ineffective and the prognosis uncertain.

Summary

In considering the diagnosis and prognosis of those affected with either of these diseases, certain findings and opinions may be of help.

Histoplasmosis

Comparatively few cases of the severe form have been reported. The results have been either fatal or productive of chronic progressive disease. Although the diagnosis of those infected with this type may be difficult, the signs and symptoms are those of severe illness, and it is unlikely that they would be considered for even a preliminary life insurance examination.

Obviously, those cases presenting evidences of calcification constitute a problem in diagnosis and prognosis. What is the significance of these calcifications?

It does not seem reasonable to suppose that this disease is one that has developed in the past few years. One can more readily assume that it has existed for generations.

It was brought into focus after 1940 by tuberculin and x-ray surveys and the routine roentgenologic chest examinations of candidates for military service.

Most of those showing calcifications have been normal individuals with neither history nor symptoms of previous pulmonary disease. There is no evidence to date that reactivation or subsequent infections occur. One very remote possibility is that calcium of sufficient amount to affect vital capacity has been deposited.

Here are the opinions of Dr. Carl R. Howson (9), of Los Angeles, California, and Dr. Herbert Mantz (10), of Kansas City, Missouri, in personal communications.

Dr. Howson says:

"I have the impression that these former infections are probably of no importance in regard to the future health of the individual."

Dr. Mantz states:

"In this territory, there is a tremendous amount of calcium, and our testing has shown that it is ten times more likely to be histoplasmin than it is to be tuberculous. Of course, there are many insurance applicants who have been rejected from the Army for tuberculosis purely on the basis of calcific densities, and I imagine this is where most of your trouble arises. If they have a positive tuberculin test, this complicates the matter; but unless there is good strong evidence of contact to an open case and they are also positive to histoplasmin, I would not worry much about tuberculosis."

No contrary opinion has been expressed.

Sarcoidosis

This disease presents a more unfavorable picture.

We know that its cause is unknown. The possibility of tuberculosis as an etiologic factor persists, and should that possibility be removed the high mortality from tuberculosis in those affected with it still presents an undesirable feature.

Epidemiologic investigations are incomplete. Unknown areas of greater incidence are being discovered. In the October, 1950, issue of the American Review of Tuberculosis, Michael, Cole, Beeson and Olson state that in their study of 350 cases more were born in Southern United States than in any other region. These findings were in both whites and negroes, so race alone is not a factor. They further state that the birthplaces of those affected are predominantly rural.

To be considered, also, are the facts that sarcoidosis is a disease of early and middle life noted for remissions and exacerbations.

There is no known therapy.

In the light of present information, those affected would not seem to be desirable insurance risks.

BIBLIOGRAPHIES — HISTOPLASMOSIS

1. Long & Stearns — Radiology 41:144 (1943).
2. C. E. Palmer — Non-tuberculous pulmonary calcification and sensitivity to histoplasmin — Pub. Health Rep. 60:513-520 — 1945.
3. Charles Edward Smith — Med. Clinics North America — May 1943.
4. Amos Christie and J. C. Peterson — Pulmonary calcification in negative reactors to tuberculin — Amer. Journ. Pub. Health — Vol. 35 — Nov. 1945.
5. David T. Smith — Fungus Diseases of the Lungs.
6. Aronson, et al — Relationship of coccidioidomycosis to calcified pulmonary nodules — Arch. Path. 34:31 — 1942.
7. Prior, Wilce and Pachanis — Public Health Report Sept. 1, 1950 — Vol. 65 — No. 35.
8. Bunnell and Furculow — 10 Proved cases of histoplasmosis — Public Health Report — March 5, 1948.
9. Carl R. Howson — Los Angeles, Cal. — Personal communication.
10. Herbert L. Mantz — Kansas City, Mo. — Personal communication.

BIBLIOGRAPHIES — SARCOIDOSIS

1. Pinner, M. — Non-Caseating Tuberculosis — Am. Rev. Tuberc. 37 — 1938.
2. Hutchinson, J. — Illustrations of Clinical Surgery, London 1875.
3. Besnier, E. — Lupus Pernio de la Face Ann. de Dermat. & Syph. 1889 — 10 — 333.
4. Boeck, C. — Multiple Benign Sarcoid of the Skin — J. Cutan. & G. U. Dis. 1889 — 17 — 543.
5. Kienbock, R. — Zur Radiographischen Anatomic Und Klinich der Syphilitishen Knocher — kraukunger in Extremitaten Ztschr F. Heilk — 1902 — 23 — 130.
6. Jungling, O. — Osteitis Tuberculosa Multiplex Cystica — Fortschr. a. d. Geb. d Roentgenstraulen — 1919 — 27 — 375.
7. Kuznitsky, E. & Bittorf, A. — Boecksches Sarkoid Munchen Med. Wchnschr — 1915 — 63 — 1349.
8. Riesner, D. — Boecks Sarcoid and Systemic Sarcoidosis — Am. Rev. Tuberc. 1944 — 49 — 289 — 437.
9. Longcope, W. T. — Boecks Sarcoid — Johns Hopkins Hosp. Bulletin Vol. 60 — 1937 — 223.
10. Rubin, E. H. & Pinner, M. — Sarcoidosis Am. Rev. Tuberc. 1944 — 49 — 146.
11. Snapper, I. — On Boecks Sarcoid — Conn. Med. Journ. 1948 — 12 — 99.
12. Moyer, J. & Ackerman, A. — Sarcoidosis — A clinical and roentgenological study of 28 cases — Am. Rev. Tuberc. 1950 — Vol. 61 — 299.
13. Freiman, D. — Sarcoidosis — N. E. Journ. of Med. 1948 — Vol. 239 — 664 — 709 — 743.
14. Riley, E. — Boecks Sarcoid — A Review based on a clinical study of 52 cases — Am. Rev. Tuberc. 1950 — Vol. 62 — 231.
15. Kissmeyer, A. — La Maladie de Boeck — Copenhagen — Levin & Munksgaard — 1932.

PRESIDENT UNGERLEIDER — Thank you, Dr. Campbell. This excellent review is now open for discussion. Those of us who look at x-ray films daily are confronted with films of this nature presenting calcification. The first time I encountered it some 15 or 18 years ago, it was presented to me by the late Dr. Bradshaw of the Mutual Life Insurance Company. At that time, the Mutual Life did not have an x-ray department. He brought films over to me full of calcifications, and the only thing I thought it could be was healed miliary tuberculosis. He put all of them up and they were all on different people, different ages, and all had scattered calcification. I

did not know the cause for it. They were all in one family, and it seemed odd that miliary tuberculosis had healed in all. They were in a fine family down in Kentucky.

The interesting thing about that particular group, in the light of subsequent events, is that there is only one thing it could have been. They were all infected with histoplasmosis. I regret I do not remember the name of the family, but I know the Mutual Life did insure them.

Is there any other discussion? If not, have you anything further to say, Dr. Campbell?

DR. CAMPBELL — I should like to ask whether anyone has a different opinion about histoplasmosis? There is nothing in the literature.

PRESIDENT UNGERLEIDER — We have been getting quite a few of them, and have been accepting them without x-rays. We feel that the calcifications are benign and do not have any relation to mortality. As a matter of fact, in our experience, reported before the American Life Convention, in a paper on pulmonary tuberculosis, we found practically normal mortality ten years after recovery.

We shall now have the pleasure of hearing from one of our members on a subject of interest to all. Dr. H. Clive McAlister, Medical Director, Lincoln National Life Insurance Company, will present a paper on "Underwriting the Highly Substandard Risk".

UNDERWRITING THE HIGHLY SUBSTANDARD RISK

H. CLIVE MCALISTER
Medical Director
Lincoln National Life Insurance Company
Fort Wayne, Indiana

The most pertinent thing that can be said on this subject is that no essential distinction can be made either in theory or principle between the underwriting of the highly impaired risk on the one hand, or on the other the underwriting of the moderately or slightly impaired risk and even of the standard risk. However, as the expected mortality rate rises, progressive changes in certain characteristics occur which demand corresponding adaptations of practical handling. With these considerations in mind we may localize the subject, by defining a high mortality rate as one involving at least three times the standard rate.

It is a fact that life insurance operated for centuries without benefit of the medical profession. It was not until 1824 — just a century and a quarter ago — that medical men became an integral part of the industry. However, they quickly proved so useful that the medical director became an important figure in the company councils. His duty was to establish and enforce morphologic, physiologic and psychologic normals for his company, and for this function he at that time needed no more information than he acquired in school and in practice. The resources of clinical medicine were sufficient. There was therefore little pressure for a new and distinctive life insurance medicine. At the very end of the last century and early in the present one, with the development of the mortality study, the first beginnings of substandard insurance, the rise in relative importance of mortality savings, and the introduction of the numerical system of risk evaluation, there

came the suspicion that clinical prognosis alone in its traditional form was not enough. The intervening half century has crystalized that suspicion into a conviction and has given some definite notion of the direction which we must take.

These present days are important in the history of the medicine of life insurance. We have deliberated upon the advisability of an independent medical organization designed to promote special interest, study, and accomplishment in the particular application of medicine to this field which has been a life interest to most of us. The implication is that for the restricted purposes of life insurance as it exists at present, there must be a significantly different order of medical knowledge and procedure beyond that contemplated in the familiar clinical system which we have been taught and which most of us have practiced. The argument must maintain that the new system has a particular, and exclusive, usefulness on behalf of a great segment of the population whom we would serve, and therefore constitutes a distinctive contribution to the welfare of mankind not so effectively available through any other mechanism yet devised. It is an ordering of things medical that is not widely understood and therefore it is inadequately recognized by formal medicine. In fact, it is definitely unpopular at present and lacks sympathy and support from clinical medicine. Yet, it has contributed in no mean fashion to the sum total of medical knowledge and if properly exploited it can contribute much more that will not become available from any other source.

Please note that the new order is something supplementing, and superimposed upon, rather than replacing or even modifying clinical medicine. Its use for life insurance purposes is intended only after all the clinical indications concerning individual applicants have been considered so far as may be practical. It is not a short cut around the complex and difficult detail of familiar medicine, nor a substitute for it, but rather a reviewing, re-arranging and contributing of medical data by new methods in fulfillment of new indications and involving new viewpoints.

The move to organize formal recognition of our medicine has emphasized its immaturity. We are as yet without expressed agreement as to what a medical director should know, or as to how or what a student of the subject should be taught. In the hope that this paper may sometime prove enlightening to students of the subject, some material is included that may be over familiar or even trite to accustomed ears. This material is pertinent to the subject because I do not believe that high risk business can be successfully carried unless it has been underwritten with the principles to be described firmly in mind.

A splendid beginning has been made in devising a curriculum for students of life insurance medicine by the Committee for the Promotion of Life Insurance Education. The response to these efforts must be immensely gratifying and encouraging to the Committee members and sponsors, but of much greater importance is the eminent significance of the success of the course. The published papers and discussions will be a welcome addition to a literature at present all too scanty and insufficiently organized.

A general statement as to the position of this paper on modern medical underwriting, particularly of high risk cases, is outlined briefly in question and answer form.

QUESTION: Why is the formal clinical medicine of our forefathers unsuitable for modern life insurance purposes?

ANSWER: Because clinical prognosis is the weakest of the Medical Arts. It attempts to forecast the duration of life remaining to individuals, a task not possible to do with accuracy. Every unexpected death reported in your daily paper is tragic testimony to this weakness. Every rejected case that lives on and on and on is an incorrect prognostication.

QUESTION: Is there any other more accurate system of prognosis that is practical?

ANSWER: Yes — a system wherein a group of individuals rather than the single individual is the unit. This form of prognosis tells us how many of the group will die in any given year. It does not tell us which ones will die.

QUESTION: How are specific applicants fitted into such a system?

ANSWER: Each is classified into the groups in which he belongs and he is debited or credited with the mortality figures attached to his groups. The characteristic operation is classification.

QUESTION: Why is such a group system superior?

ANSWER: Because, whereas the future of the individual cannot be foretold with accuracy, under certain conditions the mortality behavior of the group approaches a constant and therefore can be predicted within remarkably small limits of error. We make distinctions of mortality of the order of 0.08 per cent or less per year — a minuteness not approached in clinical medicine.

QUESTION: What are these conditions?

ANSWER: Mortality behavior within the group approaches a constant when the group is very large and when, with respect to those factors which affect mortality, it is homogenous and remains in a constant environment.

A word is needed regarding group environment. The chief factors affecting mortality classifiable under this heading are pandemic, war, economic depression and changes in the secular mortality. The influenza pandemic of 30 years ago is the last of that kind of thing in our experience. As you know, there is warrant to expect that the slaughter of that day will not be repeated even if a new pandemic occurs; yet it is probably wise to lay aside a small special reserve from the profits of favorable years in preparation for such a possible misfortune. War as we have known it affects mortality chiefly among the youth and young adults. These are the age groups in which mortality savings are relatively high and exposures low; yet we have recently seen such clear evidence of severe anti-selection that some form of restriction seems indicated. The last war saw something of civilian participation in the excesses of mortality from bombing and other forms of offense in countries near the centers of battle, and a

new war might not leave this fair land unscathed. Atomic warfare involving civilians is too terrible a prospect to be included in this purview. No doubt, in the event of such a disaster some new form of economy would be evolved in which the position of insurance cannot be foreseen.

The influence of economic depression upon group mortality was illustrated 20 years ago. The general mortality does not deteriorate, but special groups suffer materially, particularly those characterized by very large policies. Excess deaths are due chiefly to violence, notably suicide.

The general secular mortality has been steadily improving ever since reasonably accurate figures became available about the seventies of the last century. The improvement has been accompanied by progressively falling premium costs, but there are interesting side lights upon the process as it affects the mortality pattern in certain groups. Dr. Earl C. Bonnett and Mr. Lew of the Metropolitan Life Insurance Company, in a paper reported in the **Transactions** of this body (Vol. XXIX), pointed out that if listed by deaths per thousand of exposure per year, their large experience with one heart murmur group observed from 1925 to 1941 did not vary materially from that reported by The Medical Impairment Study covering 1909 to 1928. Due to improved general mortality, had the two identical studies been computed upon the actual basic mortalities of the exposure periods, there would have been much larger mortality figures for the later study, just as an offshore rock appears larger and larger as the tide ebbs. On the other hand, we can confidently expect that certain infection groups, notably osteomyelitis, mastoiditis, and appendicitis, will show an improvement much better than that of the general secular mortality.

Group size is of the greatest importance in determining a relative constancy of the mortality pattern. In fact, it appears to be prized by the actuary above all other attributes. This is undoubtedly due to his experience with group and wholesale insurance, non-medical business, and other classes that exhibit size more clearly than any other characteristic. In

general, medical men are not sufficiently impressed with this factor.

Concerning standard business, large groups are easily accumulated. In borderline and low excess mortality groups, the numbers are also satisfactory in most companies of good size. Undoubtedly it was the leveling influence of group size that masked the inefficiencies of purely clinical selection in the earlier days of substandard business. It is important to note that with large numbers and such mortality study more elaborate classifications are warranted, as in build variations or the commoner heart impairments. But with increasing mortality values, the group size shrinks progressively until the death rate may become erratic, and at last uncontrollable, by reason of small group size alone. There is therefore no scope or safety for highly impaired groups except in those organizations that can command a sufficient volume of this type of business. These characteristics are capable of accurate mathematical definition and the precise details are in the province of the actuary, but that fact does not debar the medical director from appreciating them and giving them due credence and weight in determining his influence upon the policies and practices of his organization. In fact an outstanding requirement for the successful handling of high risk groups is practical and effective cooperation for mortality study and group isolation between the actuary on the one hand and medical director on the other.

The final group quality upon which mortality depends is homogeneity. This is the aspect that appeals most to the medical mind and is the department in which the doctor is most skilled. In highly impaired cases he is able to make many distinctions which he is sure affect mortality one way or the other, and his clinical conscience and sense of justice urge him almost irresistably to translate those distinctions into ratings. His distinctions are sound enough but their interpretation in terms of ratings assumes a knowledge that in the main is not yet available. It cannot be done equitably and should not be attempted. Only the most general and simplest of subclassifications are warranted, and even then

the experience should be checked by periodic formal mortality study.

There remain certain individual cases among high risk business for which no groups exist. There are also others, the classification of which is uncertain. If the temper of the company permits, there is room for acceptance of these for small amounts to form experimental groups. For such, some form of approximate rating can be arrived at from clinical judgment, analogy to matured groupings or other stop-gap method until a sounder indication of the proper value is available. This is the method planned by Rogers and Hunter and is a spearhead of advance in life insurance medicine.

The company with which I have the honor to be associated has written highly substandard risks for upwards of 25 years. It believes that with sound underwriting based upon the principles discussed, and with accumulating experience, these risks can be carried without loss. It has deemed itself large enough to handle restricted retentions at ratings that anticipate overall mortalities up to 500 per cent. It believes that these efforts are of valuable assistance to agency forces and a special service to a segment of the public that is in special need of insurance. By this means we more completely discharge our obligation to the public.

We have found this business to be more expensive to put upon the books than are less hazardous or standard type cases. Not only are special examinations and attending physician's statements more frequently necessary, but fewer policies are placed. During the representative years of 1946 and 1947 our not-taken rate, excluding reinsurance, was 38 per cent by number and 43 per cent by amount. This was our experience in spite of preliminary applications and other devices to keep the rate down. In mitigation of these figures it must be remembered that in large numbers of these cases, the expense had already been incurred before the classification as a high risk was assigned. In these, many cases where placements were effected represented salvage of money already spent.

As is to be expected, anti-selection is a constant threat. Some of our claims show it clearly. This is one of the penalties for carrying this type of risk. It can be controlled only by constant vigilance by the underwriter for those sometimes unobtrusive red flags that so strongly suggest the danger — overinsurance, "routine" physical examinations, omitted items of insurance history, brevity, vagueness and generality of statement, forgotten physicians' names, and the like.

Once this business is on the books, it shows an above average indicated persistency rate. Of all policies issued upon a substandard basis and paid for in the period 1931 to 1946, there remained in force on the anniversary in 1946 about 61 per cent. The average estimated mortality was 164 per cent. Of cases rated to cover an excess of 100 per cent, this form of persistency figure is 65 per cent. Cases rated higher gave a figure of 68 per cent. Cases rated highly for habits showed an abnormally low persistency rate, and if these are excluded the rate becomes 69.4 per cent. Please note that these rates are crude because they have ignored variations by age at entry, years of issue, duration, and other modifying characteristics.

During the exposure period there is some additional expense due to rehandling as a result of excess applications for reconsideration and reduction of ratings. This expense is a definite factor even though, by some prior arrangement, the costs of re-examination and of physicians' statements are not borne by the company.

Our overall mortality experience of highly impaired risks has been fairly satisfactory. During the 15 year period 1931 to policy anniversaries in 1946, based upon Miller's table with multiples, it has been by amounts 66 per cent for cases rated 200 per cent and 64 per cent for cases assigned higher ratings. This study involved expected claims of about 2 1/3 millions of dollars. It must be stated in all fairness that the figures from impairment to impairment varied within wide limits and also that Miller's table does not express current mortality nor even the mortality of the later years of the exposure, but

they do support the thesis that under certain restricted conditions and subject to certain penalties, the highly impaired risk can be accepted without loss.

Summary

The underwriting of highly substandard risks does not vary in principle from the underwriting of any other grade of risk.

The fundamental operation of all underwriting is classification.

The reasons for evaluation by classification rather than by primary individual appraisal were discussed.

The factors governing the constancy of the mortality within groups were also discussed.

It is a thesis of this paper that a knowledge of group behavior is not only a proper part of life insurance medicine but is one of its distinctive characteristics.

An experience of the not-taken-out rates, crude persistency rates, and mortality rates of high risk business was presented.

PRESIDENT UNGERLEIDER — Thank you, Dr. McAlister. This interesting paper is now open for discussion.

DR. LINFORD H. LEE — I should like to ask Dr. McAlister to comment on whether there is a greater tendency for request of reduction of ratings in these higher groups than in those of 200 per cent mortality and under.

DR. HENRY A. BANCEL — I should like to ask Dr. McAlister how they ever get enough cases in the really highly impaired classifications to get reasonably accurate mortality figures.

MR. ANDREW WEBSTER — After listening to Dr. McAlister, there are one or two points not clear in my mind. He mentions, of course, that there are certain important aspects of each group in the more highly rated cases, or, for that matter, the lower rated cases, and one of them is homogeneity. It seems to me from my own limited experience that it is extremely difficult to get homogeneity in a highly rated group.

I am not trying to anticipate his answer, but he does take care of it in some respects by using a wider range in his more highly rated group, because the possibility of fluctuation in the mortality rate is sometimes greater. But in measuring his results, on which he gave some figures in his paper, does he take into account the particular impairments, or merely the group as a whole? In other words, for those of us who are trying to do highly substandard underwriting, can we throw them all into one pot and hope the result comes out well, which is quite a practical way to do it, or do we try and subdivide them a little more finely?

DR. EDGAR W. BECKWITH — I just want to ask Dr. McAlister what percentage of cases, either by lives or by amounts, they accept over 300 per cent.

DR. MCALISTER — As to the additional examinations, unfortunately I do not have exact figures. I am under the impression that the proper answer would be that additional examinations in highly substandard business are somewhat higher than they are in other substandard business, but not proportionately according to the indicated mortality. They are, of course, very much more important than they are in standard business.

How do we get the large numbers? Well, that's a function of the size of the company, and also of a company which is known throughout the industry as handling this class of business. It means that these cases are sorted out all over the country and come into certain centers, of which we have the honor to be one.

I did not notice Mr. Webster here. I might well have been embarrassed had I known he was here, because he knows a great deal more about the principles and detail of group behavior than I do. The question of homogeneity in the larger groups, I think, works this way. By making few subdivisions of high mortality risk groups, one gets a "homogeneity of heterogeneity". Now that is a little complex, but I think it is fundamentally sound.

It is true, as I mentioned in the paper — and this paper did not concern individual groups; it concerned the business as a whole — that individual groups to which we have applied these high mortality rates have varied within wider limits than has the mortality of the less impaired groups.

What percentage are accepted at over 300 per cent mortality? Do you mean what percentage are accepted by the applicant, or what percentage are accepted by the company?

DR. BECKWITH — By the company.

DR. MCALISTER — I have given you the figure for the acceptance by the applicant, which is pretty substantial. I am sorry, but I cannot give you the company rejection figure. I do not think it is very high.

PRESIDENT UNGERLEIDER — The final paper on our program concerns the electrocardiogram in insurance medicine. Dr. Kenneth F. Brandon, Associate Medical Director, and Dr. Mather H. Neill, Assistant Medical Director, Aetna Life Insurance Company, have reviewed their experience, and Dr. Brandon will present their paper.

THE USE OF THE ELECTROCARDIOGRAM IN TWENTY-FIVE YEARS OF INSURANCE SELECTION

KENNETH F. BRANDON, M. D.
Associate Medical Director
MATHER H. NEILL, M. D.
Assistant Medical Director
GORDON C. STREETER
Assistant Actuary
Aetna Life Insurance Company
Hartford, Connecticut

Since 1924 the Medical Department of our company has kept a separate file of each electrocardiogram obtained as evidence of insurability in applications for life insurance. With the new leads and our growing awareness that certain irregularities were not all pathologic and that physiologic variations could be increasingly identified, our underwriting attitudes changed. We, therefore, have not been consistent in our underwriting of electrocardiographic abnormalities. We have been consistent, however, in classifying each tracing and in handling each case individually and in recording our conclusions as to whether the electrocardiogram had been considered favorable or had adversely affected our rating of the risk.

With our contemporaries, the interests in specific irregularities, like the deep Q_3, low amplitude T waves, the low voltage QRS, the prolonged P–R interval, have changed to an interest in the whole patterns of these electrocardiograms.

We gradually changed from a tendency to consider the electrocardiogram separately to a habit of correlating it with the anatomy and physiology of the specific heart concerned.

We would expect the electrocardiograms acquired in the process of risk selection to be quite unlike the group seen in curative medicine or in life insurance claim departments. In the latter are the grossly abnormal electrocardiograms and classical pathognomonic patterns. On the other hand, the applicant for life insurance usually believes that he is insurable. There is further self selection in the fact that if he knows his electrocardiogram is unfavorable he often refuses to comply with requests for a new one. This self selection has two effects. It gives the selection department relatively more borderline or questionable electrocardiograms about which there may be clinical disagreement, and it takes a very long time for any one company to get enough abnormal cases to make statistically significant mortality studies.

Past Practices in Obtaining Electrocardiograms in the Selection of Risks

In 1924 we had electrocardiograms on five persons applying for life insurance. In the next five years we had made electrocardiographic studies on only 151 more applicants. Since 1930 they have been obtained in greater numbers.

TABLE 1

ELECTROCARDIOGRAMS ACCORDING TO 5-YEAR PERIODS

Period	Total	Abnormal	
		No.	Per Cent
1924 – 1929	156	98	63
1930 – 1934	1081	746	69
1935 – 1939	1304	555	43
1940 – 1944	1321	672	51
1945 – 1949	2525	1116	44
Total	6387	3187	50

Through 1949 we collected 6,387 cases representing applications for $161,858,000.

In 1949 we obtained electrocardiograms on 16 per 1,000 applicants who were medically examined. In this same year 597 electrocardiograms were obtained on $16,595,000 at risk — an average of $27,795 per tracing.

Abnormal Electrocardiograms

As Table 1 shows, one-half of the electrocardiograms in this twenty-five year period were abnormal. By "abnormal" we mean that there were remarkable irregularities which were classified as such. We did not include sinus arrhythmia or negative T_3 waves as abnormal.

What per cent of our electrocardiograms showed adverse findings?

On each interpretation we have recorded whether or not the electrocardiogram was unfavorable. By "unfavorable" we meant that there were sufficient abnormal findings to cause an adverse action on our rating of the risk. This adverse action was either to apply an extra loading or, in most cases, a declination of the risk.

TABLE 2

NUMBER AND PER CENT OF ELECTROCARDIOGRAMS RESULTING IN ADVERSE EFFECT ON RATING BY 5-YEAR PERIODS

		Adverse Effect	
Period	**Total**	**No.**	**Per Cent**
1924 – 1929	156	29	18.5
1930 – 1934	1081	271	25.0
1935 – 1939	1304	196	15.0
1940 – 1944	1321	300	22.7
1945 – 1949	2525	478	18.9
Total	6387	1274	19.9

Table 2 shows the number of cases by five-year periods and the number and percentage of electrocardiograms that revealed adverse findings. It is interesting that in this period approximately 20 per cent were adverse and that in spite of our presumably much freer ordering of electrocardiograms in recent years this percentage is constant.

Is there a trend toward ordering electrocardiograms on younger risks?

In recent years, particularly since certain studies on Army personnel of World War II, there has been much more interest in coronary artery disease in younger persons. We believe that this has influenced us in the selection of life insurance risks. We are more conscious of the possibility of coronary artery disease in our younger applicants.

Has this caused us to order proportionately more electrocardiograms on our younger applicants?

Table 3 shows the percentage distribution by age of the electrocardiogram cases in the same five-year periods. This indicates that since 1945 the proportion of electrocardiograms involving persons under fifty years of age is higher.

TABLE 3

NUMBER AND PER CENT OF ELECTROCARDIOGRAMS IN CERTAIN AGE GROUPS BY 5-YEAR PERIODS

Age Groups	0 – 29		30 – 39		40 – 49		50 – 70		Total	
Period	No.	%	No.	%	No.	%	No.	%	No.	%
1924 – 1929	10	6.4	38	24.4	40	25.6	68	43.6	156	100
1930 – 1934	66	6.1	197	18.2	370	34.2	448	41.5	1081	100
1935 – 1939	81	6.3	275	21.1	474	36.3	474	36.3	1304	100
1940 – 1944	89	6.7	258	19.5	459	34.8	515	39.0	1321	100
1945 – 1949	185	7.3	586	23.2	967	38.3	787	31.2	2525	100
1924 – 1949	431	6.7	1354	21.2	2310	36.2	2292	35.9	6387	100

Reasons for Ordering Electrocardiographic Studies on Cases Presented for Selection

In the process of our selection, all electrocardiograms are ordered at the discretion of the medical underwriter. Big risk rules are the only mandatory rules requiring electrocardiograms. Otherwise, the electrocardiogram is ordered because the medical director considers it indicated either by the medical history, physical findings on examination, family history, insurance history, or because he feels that the large amount applied for warrants this extra laboratory procedure. Sometimes the applicant has had a recent electrocardiogram made and this is offered or requested.

A study of the 1,334 electrocardiogram cases submitted in 1948 and 1949 was made in order to review the reasons why we called for the electrocardiograms on these persons.

TABLE 4

REASONS FOR OBTAINING ELECTROCARDIOGRAMS ON APPLICANTS

1948 – 1949

Reason	Number	Per Cent
Big Risk Rules	97	7
Medical History	626	48
Insurance History	153	11
Family History	25	2
Physical Findings	193	14
Electrocardiogram Offered	174	13
Amounts, other than Big Risks	66	5
Total	1,334	100

It is seen in Table 4 that only 7 per cent of our electrocardiograms were obtained because of big risk rules. Another 5 per cent were requested because of our concern for the large amount applied for. Forty-eight per cent of the requests were because of the medical history. Family history caused us to request 2 per cent of the total. Fourteen per cent of the studies were ordered because of impairments found on the insurance medical examination. Another 13 per cent of the cases submitted electrocardiograms that had been done previously and loaned to us for study.

Adverse Electrocardiographic Findings According to the Reason for Obtaining

Thinking that it might be interesting to note the fruitfulness of our requests for electrocardiograms according to the reason for requesting these, we took the same 1,334 electrocardiographic cases of 1948 and 1949 and studied the number and percentage of these that had adverse electrocardiograms.

TABLE 5

UNFAVORABLE ELECTROCARDIOGRAMS
1948 – 1949

Reason	Number	No. Unfavorable	Per Cent
Big Risk Rules	97	6	6
Medical History	626	132	21
Insurance History	153	40	26
Family History	25	4	16
Physical Findings	193	46	24
Electrocardiogram Offered	174	35	20
Amount — other than Big Risk	66	7	11
Total	1,334	270	20

This indicates that 20 per cent of the cases on which electrocardiograms were ordered show what we interpreted as adverse electrocardiographic findings. Only 6 per cent of the big risk ones were unfavorable. Of the others obtained because of the amount applied for only 11 per cent were unfavorable.

Electrocardiograms obtained because of suspicious chest symptoms are shown in Table 6. All these subjects were apparently well persons with no signs or diagnosis of heart

TABLE 6

APPLICANTS WITH CHEST SYMPTOMS BUT NO OTHER CARDIAC SYMPTOMS OR DIAGNOSIS
1948 – 1949

Age	No. of Persons	Electrocardiograms Unfavorable	
		No.	Per Cent
Under 30	14	5	36
30 – 39	69	10	14
40 – 49	107	16	15
50 – 70	55	22	40
Total	245	53	22

disease. We ordered electrocardiographic studies because of a history of chest discomfort or symptoms of shoulder or arm pain that made us consider the possibility of coronary artery disease.

There were 245 such cases in the group. They are divided according to age and according to whether the electrocardiogram was considered favorable or unfavorable. Twenty-two per cent of all those persons showed unfavorable electrocardiograms. We were apparently much more often alarmed about the possibility of heart disease in the 40 – 49 year age group, which was twice as large as the 50 – 70 group, but only 15 per cent had unfavorable electrocardiograms. It will be interesting to learn on follow-up how many of these persons prematurely show diagnostic signs of coronary insufficiency. In the older group, 40 per cent of these cases yielded findings which we considered adverse.

Mortality Experience

We have collected electrocardiograms on 6,387 persons. Three thousand eight hundred and two of these have been our policyholders. We made a mortality study on these. However, terminations by other than death claims plus the group of applicants that were never insured made up a large part of the 6,387 persons. Two thousand five hundred and eighty-five persons had to be traced outside our business records.

We traced cases that had no record of death and no policies in force in our company by the many methods already described by Jimenis, Marks, Finegan and Blatherwick (1). We are extremely grateful to other life insurance companies who have graciously taken the time and effort to furnish us with much of this information.

Altogether we were able to trace 93 per cent of all the cases to January 1, 1950. Thus, we lost only seven per cent. For three-quarters of these lost cases we had information covering several years.

Aetna Mortality Experience

To study our own company's experience we evaluated the

experience on these cases against experience in the period 1930 – 1940. There are obvious errors in this. The majority of our cases were examined since then. Because of the general downward trend in mortality, this table of expected deaths is much too severe. Another error exists in that the study includes cases whether accepted standard, substandard, or rejected for life insurance. The group is not homogeneous. We do not pretend to submit a significant mortality study but we use this table as a denominator for purposes of comparison.

Table 7 shows a comparison of the mortality experience on policyholder-electrocardiogram cases according to whether they were considered favorable or adverse. The adverse electrocardiogram cases showed a mortality ratio twice that of cases with favorable tracings.

TABLE 7

MORTALITY EXPERIENCE ON ELECTROCARDIOGRAM CASES

(Those Lives Which Have Had Aetna Policies in Force Traced to January 1, 1950)

Per Cent Actual of Expected Deaths by 1930 – 1940 Ultimate Experience*

Type of Electrocardiogram	No. of Lives	Years of Exposure	Expected Deaths	Actual Deaths	Per Cent Actual of Expected
Favorable	3479	19,935.5	295.6	158	53
Unfavorable	323	1,708.5	32.2	34	106

Mortality Experience According to Specific Electrocardiographic Abnormalities

As a comparative study of the significance of certain abnormalities, we evaluated the mortality experience on all the cases that we could find against the "Contemporaneous Mortality Experience on Favorable Electrocardiogram Risks Among Aetna Life Insurance Policyholders".** As a check on the variation in the mortality ratio, we studied the mortality on these specific abnormalities in the Aetna policy-

*Transactions Actuarial Society of America, 42:325, Table 9.

**Mortality ratios equal to 53 per cent of those used in Table 7, were used for these comparisons.

TABLE 8

MORTALITY EXPERIENCE ON ALL CASES WITH CERTAIN ELECTROCARDIOGRAPHIC ABNORMALITIES

Per Cent Actual of Expected Deaths by Contemporaneous Mortality Experience on Risks Having Favorable Electrocardiograms, Aetna Life Insurance Company, 1924 – 1949, Traced to January 1, 1950

Abnormality	Number of Cases	Years Exposed	Expected Deaths	Actual Deaths	Per Cent Actual of Expected ‡
Premature Contractions	557	4618	41.5	57	137
*Premature Contractions	404	3343	29.0	41	141
Auricular Fibrillation	35	316	3.3	4	†
Abnormal P Waves	37	199	1.5	2	†
P–R 0.2 plus sec.	168	1073	12.2	21	172
*P–R 0.2 plus sec.	57	339	4.1	4	†
Complete A–V Block	10	108	1.1	3	†
Bundle Branch Block	29	149	1.6	4	†
QRS 0.1 plus sec.	268	2186	23.1	41	177
*QRS 0.1 plus to 0.12 sec.	207	1612	16.2	25	154
*Left Axis Deviation	414	2256	26.9	32	119
Low Voltage QRS	212	1556	17.9	19	106
*Low Voltage QRS	64	452	4.6	1	†
Deep Q_3 – Favorable	162	1171	11.8	9	76
– Adverse	164	1168	13.0	22	169
*T_1 Low	284	1917	18.8	36	191
*T_2 Low	171	1346	14.2	21	148
*Low T_1 and T_2	93	691	7.2	14	194
Inverted T_1 and/or T_2	164	1345	19.0	42	221
Abnormal S–T Intervals	110	812	6.0	6	100
Abnormal Precordial Leads	180	641	6.1	8	131
Abnormal Precordial Leads, 1945 – 1949	114	304	2.2	0	†
Variations in Successive Tracings	87	487	3.9	6	154

*Without other significant abnormalities. †Less than five deaths. ‡Probable error of the above per cent actual to expected is generally less than 30 per cent.

holders and also in the others. The experiences in each of these two groups were in substantial agreement.

Table 8 shows these mortality experience ratios by certain electrocardiographic abnormalities. In view of the small data available, it was not considered practical to investigate combinations of abnormalities. In this table some of the abnormalities listed are not mutually exclusive.

Certain Arrhythmias

The group of auricular, ventricular and nodal premature contractions showed a mortality ratio of 137 per cent. The same group, with electrocardiograms showing any other significant abnormalities eliminated, experienced a ratio of 141 per cent. The irritable myocardium appeared to be a significant sign as far as longevity was concerned.

Only four of the electrocardiograms showed auricular flutter. In thirty years of life exposed there have been no deaths among these.

Thirty-five cases of auricular fibrillation, followed for a total of 316 life years, have surprised us with a normal mortality experience.

Abnormal P Wave

The unusually high, notched or wide (over 0.1 second) P Waves, which once we regarded as unfavorable, so far show a normal mortality experience.

Prolonged P–R Interval

A delay in the A–V conduction time over 0.20 second was once considered unfavorable. We have modified this attitude. In fifty-seven cases, followed for a total of 339 life years, the mortality experience has been normal. However, where this sign appeared along with other significant irregularities, the experience was 172 per cent of the expected.

QRS Abnormalities

The mortality ratio on QRS conduction time over 0.1 second (with those diagnosed as bundle branch block re-

moved from the group) was 177 per cent. For some time we have been thinking that a QRS interval of over 0.10 second may be normal for some persons. To study this point we grouped persons with QRS intervals over 0.1 second through 0.12 second without any other significant abnormality. This group showed a ratio of 154 per cent.

Six cases of the Wolff-Parkinson-White syndrome, observed over a total of twenty-six years, are all living.

Our experience with electrocardiograms showing left axis deviation without other abnormalities was 119 per cent.

The standard leads that show maximum positive deviations of less than 5 mm. once caused concern, but since the advent of the precordial leads we have been increasingly optimistic about these. Our mortality experience bears out this conviction.

A Q wave in Lead III that equals 25 per cent of the maximum positive deflection in any standard lead has been recorded by us as "deep". Our past attempts to separate the physiologic from the pathologic deep Q_3 have apparently been successful.

T waves in Leads I and II that exhibit an amplitude of less than 1 mm. have been consistently recorded. Since the unipolar limb leads have come into use, we are selecting these cases with more confidence. The experience on all electrocardiographic cases showing low amplitudes in Lead I only and in both Leads I and II (without other significant abnormalities) has been 191 per cent and 194 per cent respectively.

Negative T waves in Lead I have always been considered unfavorable. Negative T waves in Lead II with certain patterns are often regarded as normal. For this study we grouped all the negative T waves in Lead I and/or Lead II. The experience was 221 per cent of the expected. Of these, inverted T_1 but upright T_2 showed fifteen deaths with a ratio of 250 per cent. In cases showing inverted T_2 but upright T_1

we had nine deaths with a ratio of 141 per cent. Those electrocardiographic cases with both T_1 and T_2 inverted suffered eighteen deaths with a ratio of 310 per cent.

Over the twenty-five year period, our conceptions of abnormal S-T or R-T intervals have changed. The favorable mortality experience on this group is probably a reflection of our mistaken concern for certain elevations of the S-T segments.

Until 1945 the majority of our electrocardiograms contained only one precordial lead. An R wave in so-called Lead IV-F with an amplitude below 4 mm. was one regarded with suspicion. Many of these electrocardiograms, if they came to us today, would be subjected to multiple precordial and unipolar limb lead studies and would probably be interpreted as normal.

That our recent criteria for normal precordial leads may be too strict is suggested by our experience on the 114 cases with so-called abnormal precordial leads seen in the last five years.

Our experience on cases showing so-called abnormal variations in successive tracings compels us to give a humble answer to the question of how much variation is physiologic and how much pathologic.

Summary

We have reviewed twenty-five years of our company's experience in obtaining electrocardiograms in the process of risk selection.

About one-half of the electrocardiograms received show abnormalities.

About one-fifth of all the electrocardiograms revealed abnormalities that were treated as adversely affecting the risk.

Only 8 per cent of the electrocardiograms we now order because of the amount at risk reveal adverse findings.

We conclude that the ordering of electrocardiograms on the basis of individual consideration is a sound practice.

Comparative mortality studies on these non-homogeneous groups exhibiting certain electrocardiographic abnormalities have given us some indication as to their significance.

Reference

1. Jimenis, Albert O.; Marks, Herbert H.; Finegan, Rexford W. and Blatherwick, Norman R.: Mortality Study of Applicants for Insurance Given a Glucose Tolerance Test, Transactions Association Life Insurance Medical Directors **31**:5, 1947.

PRESIDENT UNGERLEIDER — This very excellent discussion of the co-authors of the Aetna Life Insurance Company is now open for discussion.

DR. R. W. SCOTT — I very much enjoyed these two papers this afternoon, Dr. McAlister's and Dr. Brandon's, and I came up here with the idea, perhaps, of learning something. Ever since my first visit with you in 1934, I have become increasingly impressed, reading your proceedings, with how much you gentlemen have to contribute in the academic field. As Frank Wilson pointed out, you people were the ones to solve many of the problems that bother us as teachers of medicine for the doctors of tomorrow.

Dr. Brandon's findings are a little contrary to the current teaching regarding the prognostic significance of premature contractions, whether they be auricular, ventricular, or nodal. The current teaching, as you know, is that in the absence of other subjective or objective evidence of heart disease, we are not justified solely on the basis of premature contractions in saying anything about the patient's cardiac future. His experience is very interesting to me because I have always believed, and so taught my students, that we are never justified in saying anything about the heart to the patient who exhibits nothing but premature contractions.

I wonder if the experience in other companies has been the same as Dr. Brandon's. I wonder, also, whether or not premature contraction exhibited in a cardiogram as frequently as every other beat, every third beat or every fourth beat, and shown to disappear completely on exercise, means anything in insuring the individual. I have always thought that pre-

mature contractions which disappear on effort meant nothing, whereas premature contractions that appear with effort mean a great deal.

Often we have great difficulty in determining whether the patient's symptoms are in his head or in his heart. I have prepared a lecture for students based on some 25 years of experience entitled "Differential Diagnosis of Pain in the Chest, A Comedy of Errors." The final diagnosis in these cases was determined by subsequent study, autopsy, or otherwise, although the patient had been diagnosed as having coronary disease and turned out to have something entirely apart from the heart. This error occurs particularly in people who are malingerers, who are on the disability claim list, or those approaching the age of 60 who decide it is about time to go on the insurance payroll and come in complaining of pain in the chest.

We know that persons with hypertension and diabetes of over 10 years' duration have a high incidence of coronary thrombosis, whether it ever manifested itself clinically or not. For the past 12 years, I have used the exercise test in private practice almost routinely in men over 45 years of age who consult me for an opinion as to how their machinery is holding up with 45,000 miles on the speedometer. I have been impressed over the years with the frequency with which I have been able to demonstrate significant S-T depressions after effort, where everything else about the examination was 100 per cent normal. Then I am reminded of a few patients I have seen over the years who complained of nothing but dyspnea upon exertion. I will cite just one case. It could not be called angina pectoris. But here, for example, was a 45-year old man who consulted me five years ago. His sole complaint was shortness of breath. He was the type of man who was very poised and calm. He had gone to his family doctor who could not find anything wrong. He prescribed digitalis without much improvement. In the course of some weeks the physician referred him to me for an opinion. I examined this man, and could not find anything wrong. His heart sounds were not remarkable. His heart was normal

in size and shape. He had a 100 per cent vital capacity, and a normal electrocardiogram. After exercise an electrocardiogram showed every other beat to be a premature ventricular contraction, where he had had none before, and very significant S-T depression. Obviously the diagnosis was coronary insufficiency. He had absolutely no pain — I went into that in great detail. Six weeks later this gentleman died in his sleep.

It is routine with me, but I wonder if it would not be well to order an exercise test in life insurance examinations on questionable cases. An electrocardiogram should be taken immediately after, and one five or six minutes thereafter. Occasionally there is a patient who will have no significant changes immediately thereafter, but five or six minutes later there will be some.

PRESIDENT UNGERLEIDER — Dr. Brandon, toward the end of his remarks, had some cases of Wolff-Parkinson-White's syndrome without any deaths. I wish we had the same luck. This syndrome, we feel, is not as benign as Dr. Wolff and Dr. White would have us believe.

Dr. Scott brought up this question of premature contractions. As a result of a study in our own laboratory some years ago, we found that when the rate of the heart was increased, or an extrasystole appeared or became more frequent, this was significant of heart disease. We also found that when the heart was accelerated, if there was a so-called shower or succession of extrasystoles or premature contractions, that heart was impaired. I think there were also other criteria in that particular study.

There was another study in which we took pulse tracings, and whenever pulsus alternans showed up we found significant heart disease.

In those cases where premature contractions disappeared on exercise and were purely auricular they gave a pattern of normal mortality or better than normal mortality. I think this is a very significant paper. It is unfortunate we had to

schedule it at this time of the day. Twenty-five years of experience is a significant period and I want to commend the authors for this very fine presentation.

DR. SCOTT — You implied that the premature contraction, when it disappeared, gave you a normal mortality.

PRESIDENT UNGERLEIDER — That is correct.

DR. SCOTT — Would you comment on my question as to the wisdom or advisability of ordering an exercise test in a suspicious case of coronary disease?

PRESIDENT UNGERLEIDER — I think, personally, it is very wise, and in our own company we do it, but there is a certain hazard that insurance companies are afraid of — that is, if something should happen to the individual and he developed pain or an accident, they might be liable. I have exercised people of whom I was suspicious and they had what could be diagnosed as anginal syndome.

DR. BRANDON — Dr. Neill and I are complimented by your interest. We insist on the subjects being exercised. If we think we can afford it, we obtain an electrocardiogram on them, too. If we consider it favorable, even though it does contain extrasystoles, we give credit in our underwriting.

When exercise brings in extrasystoles or increases the ratio of extrasystoles, we are afraid of the risk generally. On the use of the exercise test, or the anoxemia test in selecting risks about which we are suspicious, as far as their coronary system is concerned, we are afraid to order them, and we sometimes experience agency pressure. They say, "Doctor, what can we do to prove to him that he is all right? You claim he has heart disease. What shall we do?"

Our answer generally is, "We will not order it but in his place we would go to our own doctor and have an anoxemia test." We are surprised at the impunity with which the cardiologists throughout the country do anoxemia tests. We have insured a number of persons who went through that experience and presented us with a favorable result.

DR. KIESSLING — I should like to ask Dr. Brandon a question. Did you break down your mortality in premature contractions in young or old people?

DR. BRANDON — We did not.

PRESIDENT UNGERLEIDER — We now come to the end of the scientific program, and the end of a very happy year for me. It has been a very thrilling and satisfying experience to be the president of this body. I have been helped immeasurably by our secretary, and I cannot say too many words of appreciation. I wish to thank the executive council, other officers, and the committees that served our Association during this year.

It is a pleasure to introduce our new president, Dr. Lauritz S. Ylvisaker, Vice-President and Medical Director, Fidelity Mutual Life Insurance Company, who will address us at this time.

DR. YLVISAKER — Please accept my sincere thanks for your consideration in electing me your president for the coming year. In accepting this office, I am sure I can speak for all the incoming officers when I say that we realize the responsibilities we have and that we shall want the help of everyone of you in our direction of the work of the Association for the coming year.

Your new officers will want me also, I know, to extend our compliments to the retiring president and to all those who have assisted him in arranging the meeting now coming to a close. This has been a meeting of significant accomplishments. We have heard the most important subjects in our field of work discussed by eminent authorities. Arteriosclerosis is today the cause of more than 50 per cent of all our insurance deaths and gives us the most difficult underwriting problems. Obesity has been emphasized as an unfavorable influence on mortality, and we might well consider giving wide publicity to Dr. Rynearson's discussion because of its educational value. Members of our Association have contributed their valuable experiences with other problems with which we are daily concerned in our work.

The work of our Committee for the Promotion of Life Insurance Medical Education has been endorsed, and we are all delighted that the first seminar was so well received and so thoroughly appreciated. I attended one of the sessions and came away wishing that I, twenty years ago, had had an opportunity to hear the discussions presented. We shall feel charged with the responsibility of developing these seminars further and making them an annual event.

The Board of Life Insurance Medicine has been endorsed by the Association and I hope that we can say that we are in full agreement at least on the primary purpose of the Board — "To encourage the study, improve the practice, and advance the standards of life insurance medicine". In line with this primary objective, we hope that all members will eventually find that they can give their enthusiastic support to its future development.

In addition to the educational aspects of this meeting, we have also had the opportunity to meet old friends and to make new friends of those members welcomed into the Association at this meeting. We shall leave better equipped to meet the many problems which will come before us during the coming year.

Our secretary informs me that all business incident to this meeting has been completed and I therefore declare this 59th meeting of the Association officially adjourned.

The following doctors were present at some time during the sessions:

C. B. Ahlefeld
G. E. Allen
K. W. Anderson
W. B. Aten
D. R. Auten
J. A. Avrack
Bernard Baillargeon
H. A. Bancel
N. J. Barker
G. P. Barnett
C. C. Beach
J. R. Beard
E. W. Beckwith
R. A. Behrman
M. F. Bell
M. B. Bender
W. H. Bennett
J. R. Biggs
C. C. Birchard
W. R. Bishop
J. E. Boland
William Bolt
J. M. Bond
E. C. Bonnett
M. T. Boss
K. F. Brandon
D. J. Breithaupt
A. W. Bromer
H. B. Brown
Leslie Brown
R. F. Buchan
E. R. Bush
B. F. Byrd
E. A. Burkhardt
E. J. Campbell
H. B. Campbell
P. E. Carlisle
J. P. Chapman
H. E. Christensen
R. B. Cleveland
H. A. Cochran, Jr.
N. B. Cole
H. L. Colombo
B. R. Comeau
F. R. Congdon
W. P. Constable
J. L. Cook
H. D. Delamere
E. J. Dewees
E. G. Dewis
F. R. Dieuaide
H. W. Dingman
William Dock
G. D. Dorman
T. C. Dunlop
L. B. Dunn
A. H. Faber
J. G. Falconer
R. M. Filson
R. W. Finegan
Frederick Fink
P. M. L. Forsberg
E. M. Freeland
C. E. Fronk
H. M. Frost
F. I. Ganot
D. S. Garner
J. H. Geddes
W. M. Genthner
E. E. Getman
R. A. Goodell
George Goodkin
C. D. Gossage
A. S. Graham
E. G. Graveline
Ghent Graves
C. J. M. Grisdale
R. S. Gubner
J. R. Gudger
Llewellyn Hall
F. T. Hallam
G. W. Halpenny
V. G. Hammond
O. E. Hanes
A. H. Hansen
G. M. Harwood
H. L. Hauge
W. C. Hausheer
H. M. Hawkins
E. V. Higgins
W. L. Hilliard
E. C. Hillman, Jr.
D. W. Hoare
I. E. Hoffman
J. C. Horan
T. B. Hoxie
H. W. Hudson
J. L. Humphreys
J. H. Humphries
B. L. Huntington
J. J. Hutchinson
J. R. B. Hutchinson
A. S. Irving
J. G. Irving
A. O. Jimenis
A. E. Johann
J. W. Johnson, Jr.
V. L. Karren
E. A. Keenleyside
N. R. Kelley
E. F. Kerby
C. E. Kiessling
D. G. Kilgore
C. T. Kirchmaier
H. B. Kirkland
L. A. Kochman
W. C. Lamb
Phillips Lambkin
P. H. Langner, Jr.
L. G. LaPointe
A. L. Larson
I. C. Lawler
L. H. Lee
H. R. Leffingwell
W. R. Leute, Jr.
E. H. Lindstrom
J. M. Livingston
G. W. Lougheed
G. J. Lunz

H. C. McAlister
F. M. McChesney
R. R. McCormack
A. J. McGanity
F. J. McGurl
W. G. McLaughry
George McLean
L. L. McLellan
W. J. McNamara
Charles Maertz
H. R. Magee
S. J. N. Magwood
John Malgieri
R. W. Mann
Eugene Montgomery
J. T. Montgomery
R. C. Montgomery
C. V. Mulligan
S. A. Narins
R. M. Nay
M. H. Neill
R. A. Nelson
R. E. Nicholson
W. F. H. O'Neill
J. K. T. Ormrod
C. B. Parker
A. E. Parks
J. M. Peck
D. S. Pepper
C. A. Peters
J. C. Pierson
Cullen Pitt
R. W. Pratt
W. O. Purdy
M. A. Puzak
E. J. Quinn
R. R. Rambo
O. S. Randall
J. H. Ready
C. L. Reeder
E. A. Reiman
P. V. Reinartz
W. A. Reiter
W. M. Reynolds
G. P. Robb
D. C. Roberts
A. J. Robinson
R. C. Roskelley
T. F. Ross
Frank Rossomondo
N. E. Ruud
E. H. Rynearson
D. Y. Sage
K. F. Schaefer
L. P. Schroeder
B. T. D. Schwarz
W. H. Scoins
R. W. Scott
R. C. Secor
D. L. Selby
R. E. Seth
Hall Shannon
G. A. Sheahan
E. F. Sheldon
J. T. Sheridan
R. R. Simmons
A. M. Sison
R. I. Skolnick
W. A. Smith
Isaac Sossnitz
C. G. Spivey
F. L. Springer
H. F. Starr
J. B. Steele
D. F. R. Steuart
I. R. Stidger
S. J. Streight
N. A. Sullo
L. G. Sykes
B. C. Syverson
L. J. Tedesco
G. F. Tegtmeyer
K. J. Thomson
W. B. Thornton
J. M. Trapnell, Jr.
Wallace Troup
F. D. Truax
Maurice Turcotte
H. E. Ungerleider
A. E. Venables
R. C. Voss
P. C. Waldo
F. W. Waldron
R. V. Ward
C. F. Warren
Jefferson Weed
S. S. Werth
H. E. Wiley
J. A. Wilhelm
A. A. Willander
E. S. Williams
R. L. Willis
A. C. Wilson
G. E. Woodford
L. S. Ylvisaker
R. W. Zinkann
A. F. Zipf

Also present were:

Clarence Axman
E. J. Hardin
Edward King
G. C. Kingsley
Miss A. M. Lyle
A. P. Morton
L. N. Parker
B. S. Pauley
O. G. Sherman
Otto Urbanek
A. C. Webster
P. V. Wells
J. C. Wilberding

Total attendance at all sessions, 249.

In Memoriam

Deceased since Fifty-eighth Annual Meeting

Augustus D. Cloyd, M. D.
Woodmen of the World Life Insurance Society
Died May 16, 1950

Robert M. Daley, M. D.
The Equitable Life Assurance Society
Died June 3, 1950

J. Emile Desrochers, M. D.
La Sauvegarde Assurance Company
Died April 18, 1950

Robert J. Graves, M. D.
United Life and Accident Insurance Company
Died July 12, 1950

George A. Harlow, M. D.
The Northwestern Mutual Life Insurance Company
Died May 26, 1950

Ernest M. Henderson, M. D.
Confederation Life Association
Died May 7, 1950

Andrew C. Henske, M. D.
Mutual Savings Life Insurance Company
Died July 9, 1950

Asher R. McMahan, M. D.
Columbian Mutual Life Insurance Company
Died October 17, 1950

LIST OF MEMBERS OF THE ASSOCIATION OF LIFE INSURANCE MEDICAL DIRECTORS

Charles B. Ahlefeld, M. D.	Business Men's, Kansas City, Mo.
George E. Allen, M. D.	National, Montpelier, Vt.
Joseph Altman, M. D.	Companion Life, New York City
Henry H. Amsden, M. D.	United Life and Accident, Concord, N. H.
E. A. Anderson, M. D.	Modern Woodmen, Rock Island, Ill.
Frank R. Anderson, M. D.	Pacific Mutual, Los Angeles, Calif.
Karl W. Anderson, M. D.	Northwestern National, Minneapolis, Minn.
Perry A. Anderson, M. D.	Rockford Life, Rockford, Ill.
Robert L. Anderson, Jr., M. D.	Reliance, Pittsburgh, Pa.
Thomas M. Armstrong, M. D.	Philadelphia Life, Philadelphia, Pa.
William B. Aten, M. D.	Security Mutual, Binghamton, N. Y.
Donald R. Auten, M. D.	New York Life, New York City
J. Albert Avrack, M. D.	United States Life, New York City
Bernard Baillargeon, M. D.	Alliance Nationale, Montreal, Canada
G. Holbrook Barber, M. D.	Manhattan, New York City
Norman J. Barker, M. D.	Connecticut General, Hartford, Conn.
Gordon P. Barnett, M. D.	Kansas City Life, Kansas City, Mo.

Charles M. Barrett, M. D.	Western and Southern, Cincinnati, Ohio
Daniel S. Baughman, M. D.	Security Life and Accident, Denver, Colo.
Carroll C. Beach, M. D.	State Mutual, Worcester, Mass.
J. Randolph Beard, M. D.	Mutual Benefit, Newark, N. J.
Edgar W. Beckwith, M. D.	Equitable Life Assurance, New York City
James E. Bee, M. D.	Kansas City Life, Kansas City, Mo.
Roland A. Behrman, M. D.	John Hancock Mutual, Boston, Mass.
J. V. Bell, M. D.	National Fidelity, Kansas City, Mo.
Murray F. Bell, M. D.	New York Life, New York City
Maurice B. Bender, M. D.	Guardian, New York City
Roy W. Benton, M. D.	Northwestern Mutual, Milwaukee, Wis.
C. Coleman Berwick, M. D.	Metropolitan, New York City
Francis P. Bicknell, M. D.	State Mutual, Worcester, Mass.
J. Rozier Biggs, M. D.	Peoples, Washington, D. C.
Cecil C. Birchard, M. D.	Sun, Montreal, Canada
B. Cosby Bird, M. D.	Preferred, Montgomery, Ala.
William R. Bishop, M. D.	Jefferson Standard, Greensboro, N. C.
Norman R. Blatherwick, M. D.	Metropolitan, New York City
John E. Boland, M. D.	Country, Chicago, Ill.
William Bolt, M. D.	New York Life, New York City
John M. Bond, M. D.	Northwestern Mutual, Milwaukee, Wis.
Earl C. Bonnett, M. D.	Metropolitan, New York City
M. Theodore Boss, M. D.	Home Friendly, Baltimore, Md.

J. Thornley Bowman, M. D.	London Life, London, Canada
Ernest L. Boylen, M. D.	Standard, Portland, Ore.
Kenneth F. Brandon, M. D.	Aetna, Hartford, Conn.
Albert W. Bromer, M. D.	Metropolitan, New York City
C. Frank Brown, M. D.	Southwestern, Dallas, Tex.
Frederick R. Brown, M. D.	New England Mutual, Boston, Mass.
Howard B. Brown, M. D.	Massachusetts Mutual, Springfield, Mass.
Leslie Brown, M. D.	Equitable Life Assurance, New York City
William Brueggemann, M. D.	Union Central, Cincinnati, Ohio
Ronald F. Buchan, M. D.	Prudential, Newark, N. J.
Earl R. Bush, M. D.	Western and Southern, Cincinnati, Ohio
Benjamin F. Byrd, M. D.	National Life & Accident, Nashville, Tenn.
Joseph T. Cabaniss, M. D.	Travelers, Hartford, Conn.
Edward J. Campbell, M. D.	New York Life, New York City
Hugh B. Campbell, M. D.	Phoenix Mutual, Hartford, Conn.
Paul E. Carlisle, M. D.	Prudential, Los Angeles, Calif.
Verne S. Caviness, M. D.	Occidental, Raleigh, N. C.
Laurence D. Chapin, M. D.	Massachusetts Mutual, Springfield, Mass.
John P. Chapman, M. D.	Pennsylvania Life, Health & Accident, Philadelphia, Pa.
Paul H. Charlton, M. D.	Midland Mutual, Columbus, Ohio
Edmund D. Chesebro, M. D.	Puritan, Providence, R. I.
Harry E. Christensen, M. D.	Union Mutual, Portland, Maine

Robert B. Cleveland, M. D.	Equitable Life Assurance, New York City
Joseph C. Clifford, M. D.	Aetna, Hartford, Conn.
Milton H. Clifford, M. D.	New England Mutual, Boston, Mass.
Harry A. Cochran, Jr., M. D.	Reliance, Pittsburgh, Pa.
Norman B. Cole, M. D.	Baltimore Life, Baltimore, Md.
Irwin E. Colgin, M. D.	Texas Life, Waco, Tex.
G. R. Collyer, M. D.	London Life, London, Canada
Harry L. Colombo, M. D.	National Life, Montpelier, Vt.
Frederick R. Congdon, M. D.	Berkshire, Pittsfield, Mass.
J. Lindsay Cook, M. D.	Pilot, Greensboro, N. C.
W. Pepper Constable, M. D.	Mutual, New York City
Neil L. Criss, M. D.	United Benefit, Omaha, Neb.
Howard K. Crutcher, M. D.	United Fidelity, Dallas, Tex.
Khurshed J. J. Cursetji, M. D.	Oriental Government Security Life, Bombay, India
Bryan A. Dawber, M. D.	Penn Mutual, Philadelphia, Pa.
John S. Delahaye, M. D.	Empire Life, Kingston, Canada
Harold D. Delamere, M. D.	Crown, Toronto, Canada
Aniceto Del Rio, M. D.	La Nacional, Mexico City, Mexico
Ernest J. Dewees, M. D.	Provident Mutual, Philadelphia, Pa.
Earle T. Dewey, M. D.	Metropolitan, New York City
Edwin G. Dewis, M. D.	Prudential, Newark, N. J.
Edward S. Dillon, M. D.	Penn Mutual, Philadelphia, Pa.

Harold W. Dingman, M. D.	Continental Assurance, Chicago, Ill.
Nathaniel P. Doak, M. D.	Great Southern, Houston, Tex.
Albert H. Domm, M. D.	Prudential, Los Angeles, Calif.
James P. Donelan, M. D.	Guarantee Mutual, Omaha, Neb.
Gerald D. Dorman, M. D.	New York Life, New York City
James T. Downs, Jr., M. D.	Fidelity Union, Dallas, Tex.
Thomas C. Dunlop, M. D.	Manufacturers, Toronto, Canada
Louis B. Dunn, M. D.	Postal, New York City
William W. Eakin, M. D.	Standard, Montreal, Canada
Theodore M. Ebers, M. D.	Connecticut Mutual, Hartford, Conn.
H. Glenn Ebersole, M. D.	Illinois Bankers, Monmouth, Ill.
Laurence B. Ellis, M. D.	Boston Mutual, Boston, Mass.
Jack A. End, M. D.	Northwestern Mutual, Milwaukee, Wis.
John L. Evans, M. D.	Farmers & Bankers, Wichita, Kan.
Albert H. Faber, M. D.	New York Life, New York City
J. Gilbert Falconer, M. D.	North American, Toronto, Canada
Raymond K. Farnham, M. D.	Metropolitan, New York City
Haynes H. Fellows, M. D.	Metropolitan, New York City
William S. Fewell, M. D.	Liberty, Greenville, S. C.
Ralph M. Filson, M. D.	Travelers, Hartford, Conn.
Rexford W. Finegan, M. D.	Metropolitan, New York City

Frederick Fink, M. D.	Franklin, Springfield, Ill.
Harry E. Flansburg, M. D.	Bankers, Lincoln, Neb.
James G. Forgerson, M. D.	Massachusetts Mutual, Springfield, Mass.
Philip M. L. Forsberg, M. D.	United Life and Accident, Concord, N. H.
Garth E. Fort, M. D.	National Life & Accident, Nashville, Tenn.
John M. Foster, M. D.	Capitol, Denver, Colo.
Edward M. Freeland, M. D.	New York Life, New York City
Dale G. Friend, M. D.	John Hancock Mutual, Boston, Mass.
Clarence E. Fronk, M. D.	Hawaiian Life, Honolulu, T. H.
Harold M. Frost, M. D.	New England Mutual, Boston, Mass.
F. Irving Ganot, M. D.	Prudential, Newark, N. J.
I. Kenneth Gardner, M. D.	Reliance, Pittsburgh, Pa.
David S. Garner, M. D.	Shenandoah, Roanoke, Va.
J. H. Geddes, M. D.	Northern, London, Canada
John T. Geiger, M. D.	Metropolitan, New York City
Leo Gelfand, M. D.	Constitution Life, Los Angeles, Calif.
William M. Genthner, M. D.	Continental American, Wilmington, Del.
Edson E. Getman, M. D.	New York Life, New York City
John M. Gilchrist, M. D.	Monarch, Springfield, Mass.
Ralph T. Gilchrist, M. D.	Northwestern Mutual, Milwaukee, Wis.
Edgar G. Givhan, Jr., M. D.	Protective, Birmingham, Ala.
Robert A. Goodell, M. D.	Phoenix Mutual, Hartford, Conn.

George Goodkin, M. D.	Equitable Life Assurance, New York City
Harry W. Goos, M. D.	Home, Philadelphia, Pa.
J. Keith Gordon, M. D.	Sun, Montreal, Canada
Charles D. Gossage, M. D.	Confederation, Toronto, Canada
Angus S. Graham, M. D.	London Life, London, Canada
George M. Graham, M. D.	Lincoln National, Fort Wayne, Ind.
Ghent Graves, M. D.	American General, Houston, Tex.
Marvin L. Graves, M. D.	American General, Houston, Tex.
Harris M. Gray, M. D.	Manufacturers, Toronto, Canada
Floyd M. Green, M. D.	Columbus Mutual, Columbus, Ohio.
George E. Greenway, M. D.	Western Life Assurance, Hamilton, Canada
C. J. M. Grisdale, M. D.	Connecticut General, Hartford, Conn.
Frederick O. Gronvold, M. D.	Pioneer Mutual, Fargo, N. D.
Richard S. Gubner, M. D.	Equitable Life Assurance, New York City
James R. Gudger, M. D.	Mutual, New York City
David Halbersleben, M. D.	John Hancock Mutual, Boston, Mass.
Llewellyn Hall, M. D.	Phoenix Mutual, Hartford, Conn.
F. Tulley Hallam, M. D.	State, Indianapolis, Ind.
John H. Halliday, M. D.	Australian Mutual, Sydney Australia
Gerald W. Halpenny, M. D.	Royal, Montreal, Canada
Vincent G. Hammond, M. D.	Security Mutual, Binghamton, N. Y.
Ottis E. Hanes, M. D.	Life Ins. Co. of Ga., Atlanta, Ga.

John A. A. Harcourt, M. D.	Toronto Mutual, Toronto, Canada
Charles P. Hardwicke, M. D.	Western Reserve, Austin, Tex.
Frank Harnden, M. D.	Berkshire, Pittsfield, Mass.
Garland M. Harwood, M. D.	Life Insurance Co. of Virginia, Richmond, Va.
Louis E. Hathaway, Jr., M. D.	Monarch, Springfield, Mass.
Howard L. Hauge, M. D.	New York Life, New York City
Walter C. Hausheer, M. D.	Prudential, Newark, N. J.
Harry M. Hawkins, M. D.	Old Line, Milwaukee, Wis.
Thomas L. Hawkins, M. D.	Western, Helena, Mont.
Joseph K. P. Hawks, M. D.	State Farm, Bloomington, Ill.
J. Harry Hayes, M. D.	Union, Little Rock, Ark.
Olin C. Hendrix, M. D.	New England Mutual, Boston, Mass.
Charles R. Henry, M. D.	Provident Life and Accident Chattanooga, Tenn.
Ivan C. Heron, M. D.	West Coast, San Francisco, Calif.
Eugene V. Higgins, M. D.	Manhattan, New York City
William L. Hilliard, M. D.	Equitable, Waterloo, Canada
Ernest C. Hillman, Jr., M. D.	Mutual Benefit, Newark, N. J.
Daniel W. Hoare, M. D.	Penn Mutual, Philadelphia, Pa.
Ira E. Hoffman, M. D.	Washington National, Evanston, Ill.
Joseph C. Horan, M. D.	Metropolitan, New York City
Edward G. Howe, M. D.	Prudential, Newark, N. J.
Thomas B. Hoxie, M. D.	New York Life, New York City
Henry W. Hudson, M. D.	Loyal Protective, Boston, Mass.

John L. Humphreys, M. D.	Reliance, Pittsburgh, Pa.
James H. Humphries, M. D.	Home, New York City
J. Edward Hunsinger, M. D.	Republic Nat'l, Dallas, Tex.
Benjamin L. Huntington, M. D.	John Hancock Mutual, Boston, Mass.
Samuel W. Hurdle, M. D.	Security Life & Trust, Winston-Salem, N. C.
John J. Hutchinson, M. D.	New York Life, New York City
J. Raymond B. Hutchinson, M. D.	Acacia Mutual, Washington, D. C.
Albert S. Irving, M. D.	Commonwealth, Louisville, Ky.
J. Grant Irving, M. D.	Aetna, Hartford, Conn.
Samuel Jagoda, M. D.	State Reserve, Fort Worth, Tex.
Albert O. Jimenis, M. D.	Metropolitan, New York City
Albert E. Johann, M. D.	Bankers, Des Moines, Iowa
Hubert R. John, M. D.	Maccabees, Detroit, Mich.
Joseph W. Johnson, Jr., M. D.	Interstate Life and Accident, Chattanooga, Tenn.
Victor L. Karren, M. D.	Home, New York City
Edward A. Keenleyside, M. D.	Prudential, Toronto, Canada
Charles H. Kelley, M. D.	Columbian National, Boston, Mass.
Newell R. Kelley, M. D.	Phoenix Mutual, Hartford, Conn.
Herbert B. Kennedy, M. D.	Woodmen of the World, Omaha, Neb.
Harry B. Kidd, M. D.	Metropolitan, New York City
Charles E. Kiessling, M. D.	Prudential, Newark, N. J.

Donald G. Kilgore, M. D.	Republic National, Dallas, Tex.
Ray E. King, M. D.	Bankers, Des Moines, Iowa
Henry B. Kirkland, M. D.	Prudential, Newark, N. J.
Edward Kuck, M. D.	Union Central, Cincinnati, Ohio
Earl J. Kuenster, M. D.	Paul Revere, Worcester, Mass.
Paul Kurzweg, Jr., M. D.	All American Assurance, Lafayette, La.
Walter C. Lamb, M. D.	Equitable Life Assurance, New York City
Phillips Lambkin, M. D.	Guardian, New York City
Paul H. Langner, Jr., M. D.	Provident Mutual, Philadelphia, Pa.
Louis G. LaPointe, M. D.	Equitable Life Assurance, New York City
H. Franklyn Laramore, M. D.	Connecticut Mutual, Hartford, Conn.
Rodney C. Larcom, Jr., M. D.	John Hancock Mutual, Boston, Mass.
Albert L. Larson, M. D.	Travelers, Hartford, Conn.
Ivan C. Lawler, M. D.	New York Life, New York City
Linford H. Lee, M. D.	Pacific Mutual, Los Angeles, Calif.
Edward P. Leeper, M. D.	Praetorians, Dallas, Tex.
Harold R. Leffingwell, M. D.	Paul Revere, Worcester, Mass.
William R. Leute, Jr., M. D.	Penn Mutual, Philadelphia, Pa.
T. Herbert Lewis, M. D.	Western States, Fargo, N. D.
George G. Lindsay, M. D.	Scranton Life, Scranton, Pa.
Everett H. Lindstrom, M. D.	Western, Helena, Mont.
James A. Livingston, M. D.	Liberty National, Birmingham, Ala.

John M. Livingston, M. D.	Mutual, Waterloo, Canada
Gladstone W. Lougheed, M. D.	Confederation, Toronto, Canada
Cabot Lull, M. D.	American, Birmingham, Ala.
Gerald J. Lunz, M. D.	Knights of Columbus, New Haven, Conn.
H. Clive McAlister, M. D.	Lincoln National, Ft. Wayne, Ind.
Frank M. McChesney, M. D.	Equitable, Washington, D. C.
William J. McConnell, M. D.	Metropolitan, New York City
George McCreight, M. D.	Bankers, Des Moines, Iowa
Arthur J. McGanity, M. D.	Dominion, Waterloo, Canada
Frank J. McGurl, M. D.	Prudential, Newark, N. J.
William G. McLaughry, M. D.	Protected Home Circle, Sharon, Pa.
George McLean, M. D.	Sun, Baltimore, Md.
Lawrence L. McLellan, M. D.	Provident Mutual, Philadelphia, Pa.
Ralph E. McLochlin, M. D.	National Old Line, Little Rock, Ark.
William J. McNamara, M. D.	Equitable Life Assurance, New York City
Charles Maertz, M. D.	Union Central, Cincinnati, Ohio
Charles D. Magee, M. D.	Missouri Insurance Company, St. Louis, Mo.
S. J. Newton Magwood, M. D.	Continental, Toronto, Canada
John Malgieri, M. D.	New York Life, New York City
Robert W. Mann, M. D.	Imperial, Toronto, Canada
Francis A. L. Mathewson, M. D.	Monarch, Winnipeg, Canada

Loren K. Meredith, M. D.	National, Des Moines, Iowa
Ignacio Mesa, M. D.	"La Latino-Americana", Mexico City, Mexico
Ernest B. Milan, M. D.	Peninsular, Jacksonville, Fla.
Lloyd C. Miller, M. D.	National Life & Accident, Nashville, Tenn.
Edward S. Mills, M. D.	Prudential Assurance, Montreal, Canada
Eugene Montgomery, M. D.	North American, Toronto, Canada
James T. Montgomery, M. D.	North American Reassurance, New York City
Richard C. Montgomery, M. D.	Manufacturers, Toronto, Canada
John F. Moore, Jr., M. D.	Mutual, New York City
J. R. E. Morden, M. D.	Massachusetts Mutual, Springfield, Mass.
Reuben A. Moser, M. D.	American Reserve, Omaha Neb.
Bernard Mount, M. D.	All States, Montgomery, Alabama
Elmer B. Mountain, M. D.	American Mutual, Des Moines, Iowa
Clifford V. Mulligan, M. D.	T. Eaton, Toronto, Canada
Frederick D. Munroe, M. D.	Fidelity, Regina, Canada
Sidney A. Narins, M. D.	Mutual, New York City
Richard M. Nay, M. D.	Indianapolis Life, Indianapolis, Ind.
Mather H. Neill, M. D.	Aetna, Hartford, Conn.
Clive P. Neilson, M. D.	Sovereign Life, Winnipeg, Canada
Richard A. Nelson, M. D.	Prudential, Newark, N. J.
Charles F. Nichols, M. D.	Penn Mutual, Philadelphia, Pa.
John B. Nichols, M. D.	Acacia Mutual, Washington, D. C.

Richard E. Nicholson, M. D.	Connecticut Mutual, Hartford, Conn.
E. Clark Noble, M. D.	National, Toronto, Canada
Andrew J. Oberlander, M. D.	National, Montpelier, Vt.
William L. O'Connell, M. D.	Union Labor, New York City
Martin I. Olsen, M. D.	Central, Des Moines, Iowa
Baldur H. Olson, M. D.	Great-West, Winnipeg, Canada
William F. H. O'Neill, M. D.	Great-West, Winnipeg, Canada
Wilbert C. Page, M. D.	Prudential, Newark, N. J.
Charles B. Parker, M. D.	Independent Order of Foresters, Toronto, Canada
Arthur E. Parks, M. D.	Canada Life, Toronto, Canada
John M. Peck, M. D.	Fidelity Mutual, Philadelphia, Pa.
D. Sergeant Pepper, M. D.	Provident Mutual, Philadelphia, Pa.
Gilberto S. Pesquera, M. D.	Metropolitan, New York City
Charles A. Peters, M. D.	Prudential Assurance, Montreal, Canada
Cullen Pitt, M. D.	Atlantic, Richmond, Va.
Roscoe W. Pratt, M. D.	New York Life, New York City
William O. Purdy, M. D.	Equitable, Des Moines, Iowa
Michael A. Puzak, M. D.	Peoples, Washington, D. C.
Louis A. Pyle, M. D.	Colonial, East Orange, N. J.
Edwin J. Quinn, M. D.	Mutual, New York City

O. Samuel Randall, M. D.	Midland National, Watertown, S. D.
Paul M. Rattan, M. D.	Great National, Dallas, Tex.
James H. Ready, M. D.	General American, St. Louis, Mo.
Rezin Reagan, M. D.	Policyholder's National, Sioux Falls, S. D.
Clifton L. Reeder, M. D.	Continental Assurance, Chicago, Ill.
Earl A. Reiman, M. D.	State Mutual, Worcester, Mass.
Paul V. Reinartz, M. D.	Prudential, Newark, N. J.
Walter A. Reiter, M. D.	Mutual Benefit, Newark, N. J.
Whitman M. Reynolds, M. D.	Equitable Life Assurance, New York City
Wallace R. Richardson, M. D.	National Equity, Little Rock, Ark.
H. Guy Riche, M. D.	Guaranty Income, Baton Rouge, La.
Donald F. Rikkers, M. D.	Northwestern Mutual, Milwaukee, Wis.
George P. Robb, M. D.	Metropolitan, New York City
David C. Roberts, M. D.	Guardian, New York City
Albert J. Robinson, M. D.	Connecticut General, Hartford, Conn.
Claude A. Robison, M. D.	Peoples, Frankfort, Ind.
Henry B. Rollins, M. D.	Connecticut Mutual, Hartford, Conn.
Gordon Ross, M. D.	Massachusetts Mutual, Springfield, Mass.
John G. Ross, M. D.	Mutual, Waterloo, Canada
Thomas F. Ross, M. D.	Ohio State, Columbus, Ohio
Edward W. Rowe, M. D.	Midwest, Lincoln, Neb.
William W. Rucks, M. D.	Home State, Oklahoma City, Okla.

Dan Y. Sage, M. D.	Southern, Atlanta, Ga.
Joe H. Sanderlin, M. D.	Pyramid, Little Rock, Ark.
Raymond C. Scannell, M. D.	Security Life and Accident, Denver, Colo.
Kenneth F. Schaefer, M. D.	Prudential, Newark, N. J.
Berthold T. D. Schwarz, M. D.	Bankers National, Montclair, N. J.
William H. Scoins, M. D.	Lincoln National, Ft. Wayne, Ind.
Robert J. Scott, M. D.	Michigan Life, Detroit, Mich.
Ralph C. Secor, M. D.	Connecticut Mutual, Hartford, Conn.
Alfred F. Seibert, M. D.	Travelers, Hartford, Conn.
David L. Selby, M. D.	Imperial, Toronto, Canada
Thomas S. Sexton, M. D.	Massachusetts Mutual, Springfield, Mass.
Hall Shannon, M. D.	Southland, Dallas, Tex.
Elroy F. Sheldon, M. D.	Occidental, Los Angeles, Calif.
Joyce T. Sheridan, M. D.	Fidelity Mutual, Philadephia, Pa.
Hubert H. Shook, M. D.	Ohio National, Cincinnati, Ohio
Ralph R. Simmons, M. D.	Equitable, Des Moines, Iowa
Jonathan C. Sinclair, M. D.	Canada Life, Toronto, Canada
F. Hartley Smith, M. D.	Great-West, Winnipeg, Canada
Stewart A. Smith, M. D.	Australian Mutual, Sydney, Australia
Wilbur A. Smith, M. D.	Equitable Life Assurance, New York City
Isaac Sossnitz, M. D.	Eastern, New York City
Marion Souchon, M. D.	Pan-American, New Orleans, La.
Charles G. Spivey, M. D.	Carolina Life, Columbia, S. C.

Frank L. Springer, M. D.	Columbian National, Boston, Mass.
H. Frank Starr, M. D.	Jefferson Standard, Greensboro, N. C.
F. R. Stearns, M. D.	Security Benefit Association, Topeka, Kan.
George G. Stebbins, M. D.	Wisconsin Life, Madison, Wis.
John B. Steele, M. D.	Volunteer State, Chattanooga, Tenn.
David F. R. Steuart, M. D.	Mutual Benefit, Newark, N. J.
Edgar M. Stevenson, M. D.	State Farm, Bloomington, Ill.
Hector M. Stevenson, M. D.	Aetna, Hartford, Conn.
Lester Q. Stewart, M. D.	Aetna, Hartford, Conn.
I. Read Stidger, M. D.	Prudential, Newark, N. J.
Frank M. Stites, M. D.	Kentucky Home Mutual, Louisville, Ky.
Samuel J. Streight, M. D.	Canada Life, Toronto, Canada
Nicholas A. Sullo, M. D.	Equitable Life Assurance, New York City.
Bion C. Syverson, M. D.	Equitable Life Assurance, New York City
Joseph L. Tansey, M. D.	John Hancock Mutual, Boston, Mass.
Louis J. Tedesco, M. D.	New York Life, New York City
Gamber F. Tegtmeyer, M. D.	Northwestern Mutual, Milwaukee, Wis.
Edward R. Thompson, M. D.	Texas Prudential, Galveston, Tex.
Hugh G. Thompson, M. D.	George Washington, Charleston, W. Va.
K. Jefferson Thomson, M. D.	Metropolitan, New York City
William B. Thornton, M. D.	Norwich Union, Toronto, Canada
Joel E. Toothaker, M. D.	Sunset Life, Olympia, Wash.

Albert R. Tormey, M. D.	National Guardian, Madison, Wis.
Grafton D. Townshend, M. D.	Standard Life Association, Lawrence, Kansas
John M. Trapnell, Jr., M. D.	Penn Mutual, Philadelphia, Pa.
Joseph Travenick, Jr., M. D.	Occidental, Los Angeles, Calif.
Wallace Troup, M. D.	Metropolitan, New York City
Francis D. Truax, M. D.	Crown, Toronto, Canada
Maurice Turcotte, M. D.	Industrial, Quebec, Canada
Harry E. Ungerleider, M. D.	Equitable Life Assurance, New York City
Bruce W. Vale, M. D.	Excelsior, Toronto, Canada
Euen Van Kleeck, M. D.	Travelers, Hartford, Conn.
Alexander E. Venables, M. D.	Minnesota Mutual, St. Paul, Minn.
Frederick H. Vinup, M. D.	Monumental, Baltimore, Md.
Reynold C. Voss, M. D.	Pan-American, New Orleans, La.
Proctor C. Waldo, M. D.	Washington National, Evanston, Ill.
Frederick A. Waldron, M. D.	Mutual, New York City
George H. Walker, M. D.	Lincoln Liberty, Lincoln, Neb.
Dick P. Wall, M. D.	American National, Galveston, Tex.
Gordon K. Wallace, M. D.	Great American Reserve, Dallas, Tex.
Kenneth E. Ward, M. D.	Connecticut General, Hartford, Conn.

R. Vance Ward, M. D.	Montreal Life, Montreal, Canada
Frank A. Warner, M. D.	John Hancock Mutual, Boston, Mass.
Robert L. Weaver, M. D.	Penn Mutual, Philadelphia, Pa.
Jefferson Weed, M. D.	Mutual Benefit, Newark, N. J.
Stephen S. Werth, M. D.	Globe, Chicago, Ill.
Howard E. Wiley, M. D.	Southwestern, Dallas, Tex.
John A. Wilhelm, M. D.	Gulf, Jacksonville, Fla.
Alfred A. Willander, M. D.	Mutual Trust, Chicago, Ill.
Earl B. Williams, M. D.	Wisconsin National, Oshkosh, Wis.
Ennion S. Williams, M. D.	Life Insurance Co. of Virginia, Richmond, Va.
Richard L. Willis, M. D.	Mutual, New York City
Archibald C. Wilson, M. D.	Connecticut General, Hartford, Conn.
C. L. Wilson, M. D.	Empire State Mutual, Jamestown, N. Y.
Don J. Wolfram, M. D.	Jefferson National, Indianapolis, Ind.
George E. Woodford, M. D.	Home, New York City
Lauritz S. Ylvisaker, M. D.	Fidelity Mutual, Philadelphia, Pa.
Donald E. Yochem, M. D.	Farm Bureau, Columbus, Ohio
Arthur W. Young, M. D.	Sun, Montreal, Canada
George G. Young, M. D.	Central, Des Moines, Iowa
Victor H. Young, M. D.	Travelers, Hartford, Conn.
Russell W. Zinkann, M. D.	Mutual, Waterloo, Canada
Albert F. Zipf, M. D.	Calif.-Western States, Sacramento, Calif.

HONORARY MEMBERS

Francis R. Dieuaide, M. D.	New York City
Arthur Hunter	New York City
Edward E. Rhodes	Newark, N. J.

EMERITUS MEMBERS

John W. Abbott, M. D.	Worcester, Mass.
Edwin H. Allen, M. D.	Boston, Mass.
Hiram H. Amiral, M. D.	Worcester, Mass.
Thomas D. Archibald, M. D.	Toronto, Canada
William B. Bartlett, M. D.	Boston, Mass.
Chester T. Brown, M. D.	Newark, N. J.
O. M. Eakins, M. D.	Pittsburgh, Pa.
Byam Hollings, M. D.	Boston, Mass.
Walter A. Jaquith, M. D.	Columbus, Ohio
George E. Kanouse, M. D.	Newark, N. J.
Francis H. McCrudden, M. D.	Boston, Mass.
Frederick W. McSorley, M. D.	New York City
William Muhlberg, M. D.	Cincinnati, Ohio
Herbert Old, M. D.	Philadelphia, Pa.
George P. Paul, M. D.	Hartford, Conn.
Charles B. Piper, M. D.	Hartford, Conn.
James M. H. Rowland, M. D.	Baltimore, Md.
Robert L. Rowley, M. D.	Hartford, Conn.
H. Crawford Scadding, M. D.	Toronto, Canada
Henry H. Schroeder, M. D.	New York City
Ernest W. Scott, M. D.	New York City
Walter E. Thornton, M. D.	Fort Wayne, Ind.
William R. Ward, M. D.	Newark, N. J.
Fred L. Wells, M. D.	Des Moines, Iowa
David E. W. Wenstrand, M. D.	Milwaukee, Wis.
Chester F. S. Whitney, M. D.	New York City
McLeod C. Wilson, M. D.	Hartford, Conn.

COMPANIES AND THEIR REPRESENTATIVES

Acacia Mutual Life Insurance Co., Washington, D. C.	J. R. B. Hutchinson, M. D. J. B. Nichols, M. D.
Aetna Life Insurance Co., Hartford, Conn.	K. F. Brandon, M. D. J. C. Clifford, M. D. J. G. Irving, M. D. M. H. Neill, M. D. H. M. Stevenson, M. D. L. Q. Stewart, M. D.
Alliance Nationale, Montreal, Canada	Bernard Baillargeon, M. D.
All American Assurance Co., Lafayette, La.	Paul Kurzweg, Jr., M. D.
All States Life Insurance Co., Montgomery, Ala.	Bernard Mount, M. D.
American General Life Insurance Co., Houston, Texas	Ghent Graves, M. D. M. L. Graves, M. D.
American Life Insurance Co., Birmingham, Ala.	Cabot Lull, M. D.
American Mutual Life Insurance Co., Des Moines, Iowa.	E. B. Mountain, M. D.
American National Insurance Co., Galveston, Texas.	D. P. Wall, M. D.
American Reserve Life Insurance Co., Omaha, Neb.	R. A. Moser, M. D.
Atlantic Life Insurance Co., Richmond, Va.	Cullen Pitt, M. D.

Australian Mutual Provident Society, Sydney, Australia.	J. H. Halliday, M. D. S. A. Smith, M. D.
Baltimore Life Insurance Co., Baltimore, Md.	N. B. Cole, M. D
Bankers Life Company, Des Moines, Iowa.	A. E. Johann, M. D. George McCreight, M. D. R. E. King, M. D.
Bankers Life Insurance Co. of Nebraska, Lincoln, Neb.	H. E. Flansburg, M. D.
Bankers National Life Ins. Co., Montclair, N. J.	B. T. D. Schwarz, M. D.
Berkshire Life Insurance Co., Pittsfield, Mass.	F. R. Congdon, M. D. Frank Harnden, M. D.
Boston Mutual Life Insurance Co., Boston, Mass.	L. B. Ellis, M. D.
Business Men's Assurance Co. of America, Kansas City, Mo.	C. B. Ahlefeld, M. D.
Calif.-Western States Life Insurance Co., Sacramento, Calif.	A. F. Zipf, M. D.
Canada Life Assurance Co., Toronto, Canada.	A. E. Parks, M. D. J. C. Sinclair, M. D. S. J. Streight, M. D.
Capitol Life Insurance Co. of Colorado, Denver, Colo.	J. M. Foster, M. D.
Carolina Life Insurance Co., Columbia, S. C.	C. G. Spivey, M. D.
Central Life Assurance Society, Des Moines, Iowa.	M. I. Olsen, M. D. G. G. Young, M. D.
Colonial Life Insurance Co., East Orange, N. J.	L. A. Pyle, M. D.

Columbian National Life Ins. Co., Boston, Mass.	C. H. Kelley, M. D. F. L. Springer, M. D.
Columbus Mutual Life Ins. Co., Columbus, Ohio.	F. M. Green, M. D.
Commonwealth Life Insurance Co., Louisville, Ky.	A. S. Irving, M. D.
Companion Life Ins. Co., New York City	Joseph Altman, M. D.
Confederation Life Association, Toronto, Canada.	C. D. Gossage, M. D. G. W. Lougheed, M. D.
Connecticut General Life Ins. Co., Hartford, Conn.	N. J. Barker, M. D. C. J. M. Grisdale, M. D. A. J. Robinson, M. D. K. E. Ward, M. D. A. C. Wilson, M. D.
Connecticut Mutual Life Ins. Co., Hartford, Conn.	T. M. Ebers, M. D. H. F. Laramore, M. D. R. E. Nicholson, M. D. H. B. Rollins, M. D. R. C. Secor, M. D.
Constitution Life Company of America, Los Angeles, Calif.	Leo Gelfand, M. D.
Continental Amer. Life Ins. Co., Wilmington, Del.	W. M. Genthner, M. D.
Continental Assurance Co., Chicago, Ill.	H. W. Dingman, M. D. C. L. Reeder, M. D.
Continental Life Insurance Co., Toronto, Canada.	S. J. N. Magwood, M. D.
Country Life Insurance Co., Chicago, Ill.	J. E. Boland, M. D.
Crown Life Insurance Co., Toronto, Canada.	H. D. Delamere, M. D. F. D. Truax, M. D.

Dominion Life Assurance Co., Waterloo, Canada	A. J. McGanity, M. D.
Eastern Life Insurance Co., New York City	Isaac Sossnitz, M. D.
Empire Life Insurance Co., Kingston, Canada	J. S. Delahaye, M. D.
Empire State Mutual Life Insurance Co., Jamestown, N. Y.	C. L. Wilson, M. D.
Equitable Life Assurance Society, New York City	E. W. Beckwith, M. D. Leslie Brown, M. D. R. B. Cleveland, M. D. George Goodkin, M. D. R. S. Gubner, M. D. W. C. Lamb, M. D. L. G. LaPointe, M. D. W. J. McNamara, M. D. W. M. Reynolds, M. D. W. A. Smith, M. D. N. A. Sullo, M. D. B. C. Syverson, M. D. H. E. Ungerleider, M. D.
Equitable Life Insurance Co., Washington, D. C.	F. M. McChesney, M. D.
Equitable Life Ins. Co. of Canada, Waterloo, Canada	W. L. Hilliard, M. D.
Equitable Life Insurance Co. of Iowa, Des Moines, Iowa.	W. O. Purdy, M. D. R. R. Simmons, M. D.
Excelsior Life Insurance Co., Toronto, Canada.	B. W. Vale, M. D.
Farm Bureau Life Ins. Co., Columbus, Ohio.	D. E. Yochem, M. D.
Farmers & Bankers Life Insurance Co., Wichita, Kan.	J. L. Evans, M. D.

Fidelity Life Assurance Co., Regina, Canada	F. D. Munroe, M. D.
Fidelity Mutual Life Ins. Co., Philadelphia, Pa.	J. M. Peck, M. D. J. T. Sheridan, M. D. L. S. Ylvisaker, M. D.
Fidelity Union Life Insurance Co., Dallas, Texas	J. T. Downs, Jr., M. D.
Franklin Life Ins. Co., Springfield, Ill.	Frederick Fink, M. D.
General American Life Ins. Co., St. Louis, Mo.	J. H. Ready, M. D.
George Washington Life Insurance Co., Charleston, W. Va.	H. G. Thompson, M. D.
Globe Life Insurance Co., Chicago, Ill.	S. S. Werth, M. D.
Great American Reserve Insurance Co., Dallas, Tex.	G. K. Wallace, M. D.
Great National Life Insurance Co., Dallas, Texas	P. M. Rattan, M. D.
Great Southern Life Ins. Co., Houston, Texas	N. P. Doak, M. D.
Great-West Life Assur. Co., Winnipeg, Canada.	B. H. Olson, M. D. W. F. H. O'Neill, M. D. F. H. Smith, M. D.
Guarantee Mutual Life Insurance Co., Omaha, Neb.	J. P. Donelan, M. D.
Guaranty Income Life Insurance Co., Baton Rouge, La.	H. G. Riche, M. D.
Guardian Life Insurance Co. of America, New York City	M. B. Bender, M. D. Phillips Lambkin, M. D. D. C. Roberts, M. D.

Gulf Life Insurance Co., Jacksonville, Fla.	J. A. Wilhelm, M. D.
Hawaiian Life Insurance Co., Ltd., Honolulu, T. H.	C. E. Fronk, M. D.
Home Friendly Insurance Co., Baltimore, Md.	M. Theodore Boss, M. D.
Home Life Insurance Co., New York City	J. H. Humphries, M. D. V. L. Karren, M. D. G. E. Woodford, M. D.
Home Life Ins. Co. of America, Philadelphia, Pa.	H. W. Goos, M. D.
Home State Life Insurance Co., Oklahoma City, Okla.	W. W. Rucks, M. D.
Illinois Bankers Life Assurance Co., Monmouth, Ill.	H. G. Ebersole, M. D.
Imperial Life Assurance Co., Toronto, Canada.	R. W. Mann, M. D. D. L. Selby, M. D.
Independent Order of Foresters, Toronto, Canada	C. B. Parker, M. D.
Indianapolis Life Ins. Co., Indianapolis, Ind.	R. M. Nay, M. D.
Industrial Life Insurance Co.. Quebec, Canada	Maurice Turcotte, M. D.
Interstate Life and Accident Co., Chattanooga, Tenn.	J. W. Johnson, Jr., M. D.
Jefferson National Life Insurance Co., Indianapolis, Ind.	D. J. Wolfram, M. D.
Jefferson Standard Life Ins. Co., Greensboro, N. C.	W. R. Bishop, M. D. H. F. Starr, M. D.

John Hancock Mutual Life Ins. Co., Boston, Mass.	R. A. Behrman, M D. D. G. Friend, M. D. David Halbersleben, M. D. B. L. Huntington, M. D. R. C. Larcom, Jr., M. D. J. L. Tansey, M. D. F. A. Warner, M. D.
Kansas City Life Ins. Co., Kansas City, Mo.	G. P. Barnett, M. D. J. E. Bee, M. D.
Kentucky Home Mutual Life Insurance Co., Louisville, Ky.	F. M. Stites, M. D.
Knights of Columbus, New Haven, Conn.	G. J. Lunz, M. D.
"La Latino-Americana", Mexico, D. F.	Ignacio Mesa, M. D.
La Nacional, Compania de Seguros Sobre la Vida, S. A., Mexico, D. F.	Aniceto Del Rio, M. D.
Liberty Life Insurance Co., Greenville, S. C.	W. S. Fewell, M. D.
Liberty National Life Ins. Co., Birmingham, Ala.	J. A. Livingston, M. D.
Life Insurance Co. of Georgia, Atlanta, Ga.	O. E. Hanes, M. D.
Life Insurance Co. of Virginia, Richmond, Va.	G. M. Harwood, M. D. E. S. Williams, M. D.
Lincoln Liberty Life Ins. Co., Lincoln, Neb.	G. H. Walker, M. D.
Lincoln National Life Ins. Co., Fort Wayne, Ind.	G. M. Graham, M. D. H. C. McAlister, M. D. W. H. Scoins, M. D.
London Life Insurance Co., London, Canada.	J. T. Bowman, M. D. G. R. Collyer, M. D. A. S. Graham, M. D.

Loyal Protective Life Insurance Co., Boston, Mass.	H. W. Hudson, M. D.
Maccabees Life Insurance Society, Detroit, Mich.	H. R. John, M. D.
Manhattan Life Insurance Co., New York City	G. H. Barber, M. D. Eugene V. Higgins, M. D.
Manufacturers Life Ins. Co., Toronto, Canada.	T. C. Dunlop, M. D. H. M. Gray, M. D. R. C. Montgomery, M. D.
Massachusetts Mutual Life Insurance Co., Springfield, Mass.	H. B. Brown, M. D. J. G. Forgerson, M. D. J. R. E. Morden, M. D. Gordon Ross, M. D. T. S. Sexton, M. D.
Metropolitan Life Insurance Co., New York City	C. C. Berwick, M. D. N. R. Blatherwick, M. D. E. C. Bonnett, M. D. A. W. Bromer, M. D. E. T. Dewey, M. D. R. K. Farnham, M. D. H. H. Fellows, M. D. R. W. Finegan, M. D. J. T. Geiger, M. D. J. C. Horan, M. D. A. O. Jimenis, M. D. H. B. Kidd, M. D. W. J. McConnell, M. D. G. S. Pesquera, M. D. G. P. Robb, M. D. K. J. Thomson, M. D. Wallace Troup, M. D.
Michigan Life Insurance Co., Detroit, Mich.	R. J. Scott, M. D.
Midland Mutual Life Insurance Co., Columbus, Ohio	P. H. Charlton, M. D.
Midland National Life Insurance Co., Watertown, S. D.	O. S. Randall, M. D.

Midwest Life Insurance Co., Lincoln, Neb.	E. W. Rowe, M. D.
Minnesota Mutual Life Insurance Co., St. Paul, Minn.	A. E. Venables, M. D.
Missouri Insurance Co., St. Louis, Mo.	C. D. Magee, M. D.
Modern Woodmen of America, Rock Island, Ill.	E. A. Anderson, M. D.
Monarch Life Assur. Co., Winnipeg, Canada	F. A. L. Mathewson, M. D.
Monarch Life Insurance Co., Springfield, Mass.	J. M. Gilchrist, M. D. L. E. Hathaway, Jr., M. D.
Montreal Life Insurance Co., Montreal, Canada	R. V. Ward, M. D.
Monumental Life Insurance Co., Baltimore, Md.	F. H. Vinup, M. D.
Mutual Benefit Life Insurance Co., Newark, N. J.	J. R. Beard, M. D. E. C. Hillman, Jr., M. D. W. A. Reiter, M. D. D. F. Steuart, M. D. Jefferson Weed, M. D.
Mutual Life Assur. Co. of Canada, Waterloo, Canada	J. M. Livingston, M. D. J. G. Ross, M. D. R. W. Zinkann, M. D.
Mutual Life Ins. Co. of New York, New York City	W. Pepper Constable, M. D. J. R. Gudger, M. D. J. F. Moore, M. D. S. A. Narins, M. D. E. J. Quinn, M. D. F. A. Waldron, M. D. R. L. Willis, M. D.
Mutual Trust Life Insurance Co., Chicago, Ill.	A. A. Willander, M. D.

National Equity Life Insurance Co., Little Rock, Ark.	W. R. Richardson, M. D.
National Fidelity Life Insurance Co., Kansas City, Mo.	J. V. Bell, M. D.
National Guardian Life Insurance Co., Madison, Wis.	A. R. Tormey, M. D.
National Life & Accident Ins. Co., Nashville, Tenn.	B. F. Byrd, M. D. G. E. Fort, M. D. L. C. Miller, M. D.
National Life Assurance Co. of Canada, Toronto, Canada	E. C. Noble, M. D.
National Life Co., Des Moines, Iowa	L. K. Meredith, M. D.
National Life Insurance Co., Montpelier, Vt.	G. E. Allen, M. D. H. L. Colombo, M. D. A. J. Oberlander, M. D.
National Old Line Insurance Co., Little Rock, Ark.	R. E. McLochlin, M. D.
New England Mutual Life Ins. Co., Boston, Mass.	F. R. Brown, M. D. M. H. Clifford, M. D. H. M. Frost, M. D. O. C. Hendrix, M. D.
New York Life Insurance Co., New York City	D. R. Auten, M. D. M. F. Bell, M. D. William Bolt, M. D. E. J. Campbell, M. D. G. D. Dorman, M. D. A. H. Faber, M. D. E. M. Freeland, M. D. E. E. Getman, M. D. H. L. Hauge, M. D. T. B. Hoxie, M. D. J. J. Hutchinson, M. D. I. C. Lawler, M. D. John Malgieri, M. D. R. W. Pratt, M. D. L. J. Tedesco, M. D.

North American Life Assur. Co., Toronto, Canada	J. G. Falconer, M. D. Eugene Montgomery, M. D.
North American Reassurance Co., New York City	J. T. Montgomery, M. D.
Northern Life Assurance Co. of Canada, London, Canada	J. H. Geddes, M. D.
Northwestern Mutual Life Ins. Co., Milwaukee, Wis.	R. W. Benton, M. D. J. M. Bond, M. D. J. A. End, M. D. R. T. Gilchrist, M. D. D. F. Rikkers, M. D. G. F. Tegtmeyer, M. D.
Northwestern National Life Ins. Co., Minneapolis, Minn.	K. W. Anderson, M. D.
Norwich Union Life Insurance Society, Toronto, Canada	W. B. Thornton, M. D.
Occidental Life Insurance Co., Raleigh, N. C.	V. S. Caviness, M. D.
Occidental Life Ins. Co. of California, Los Angeles, Calif.	E. F. Sheldon, M. D. Joseph Travenick, Jr., M. D.
Ohio National Life Ins. Co., Cincinnati, Ohio	H. H. Shook, M. D.
Ohio State Life Insurance Co., Columbus, Ohio	T. F. Ross, M. D.
Old Line Life Insurance Co. of America, Milwaukee, Wis.	H. M. Hawkins, M. D.
Oriental Government Security Life Assurance Co., Ltd., Bombay, India.	K. J. J. Cursetji, M. D.

Pacific Mutual Life Ins. Co., Los Angeles, Calif.	F. R. Anderson, M. D. L. H. Lee, M. D.
Pan-American Life Ins. Co., New Orleans, La.	Marion Souchon, M. D. R. C. Voss, M. D.
Paul Revere Life Ins. Co., Worcester, Mass.	Earl J. Kuenster, M. D. H. R. Leffingwell, M. D.
Peninsular Life Insurance Co., Jacksonville, Fla.	E. B. Milam, M. D.
Penn Mutual Life Ins. Co., Philadelphia, Pa.	B. A. Dawber, M. D. E. S. Dillon, M. D. D. W. Hoare, M. D. W. R. Leute, Jr., M. D. C. F. Nichols, M. D. J. M. Trapnell, Jr., M. D. R. L. Weaver, M. D.
Pennsylvania Life, Health & Accident Ins. Co., Philadelphia, Pa.	John P. Chapman, M. D.
Peoples Life Ins. Co., Frankfort, Ind.	C. A. Robison, M. D.
Peoples Life Insurance Co., Washington, D. C.	J. R. Biggs, M. D. M. A. Puzak, M. D.
Philadelphia Life Ins. Co., Philadelphia, Pa.	T. M. Armstrong, M. D.
Phoenix Mutual Life Ins. Co., Hartford, Conn.	H. B. Campbell, M. D. R. A. Goodell, M. D. Llewellyn Hall, M. D. N. R. Kelley, M. D.
Pilot Life Insurance Co., Greensboro, N. C.	J. L. Cook, M. D.
Pioneer Mutual Life Insurance Co., Fargo, N. D.	F. O. Gronvold, M. D.
Policyholder's National Life Ins. Co., Sioux Falls, S. D.	Rezin Reagan, M. D.

Postal Life Insurance Co., New York, N. Y.	L. B. Dunn, M. D.
Praetorians (The), Dallas, Texas	E. P. Leeper, M. D.
Preferred Life Assurance Society, Montgomery, Ala.	B. C. Bird, M. D.
Protected Home Circle, Sharon, Pa.	W. G. McLaughry, M. D.
Protective Life Insurance Co., Birmingham, Ala.	E. G. Givhan, Jr., M. D.
Provident Life and Accident Ins. Co., Chattanooga, Tenn.	C. R. Henry, M. D.
Provident Mutual Life Ins. Co., Philadelphia, Pa.	E. J. Dewees, M. D. P. H. Langner, Jr., M. D. L. L. McLellan, M. D. D. S. Pepper, M. D.
Prudential Assur. Co., Ltd., Montreal, Canada	E. S. Mills, M. D. C. A. Peters, M. D.
Prudential Insurance Co., Newark, N. J.	R. F. Buchan, M. D. P. E. Carlisle, M. D. E. G. Dewis, M. D. A. H. Domm, M. D. F. I. Ganot, M. D. W. C. Hausheer, M. D. E. G. Howe, M. D. E. A. Keenleyside, M. D. C. E. Kiessling, M. D. H. B. Kirkland, M. D. F. J. McGurl, M. D. R. A. Nelson, M. D. W. C. Page, M. D. P. V. Reinartz, M. D. K. F. Schaefer, M. D. I. R. Stidger, M. D.
Puritan Life Insurance Co., Providence, R. I.	E. D. Chesebro, M. D.

Pyramid Life Insurance Co., Little Rock, Ark.	J. H. Sanderlin, M. D.
Reliance Insurance Co. of Pittsburgh, Pittsburgh, Pa.	R. L. Anderson, Jr., M. D. H. A. Cochran, Jr., M. D. I. Kenneth Gardner, M. D. J. L. Humphreys, M. D.
Republic National Life Ins. Co., Dallas, Texas	J. E. Hunsinger, M. D. D. G. Kilgore, M. D.
Rockford Life Insurance Co., Rockford, Ill.	P. A. Anderson, M. D.
Royal Insurance Co., Ltd., Montreal, Canada	G. W. Halpenny, M. D.
Scranton Life Insurance Co., Scranton, Pa.	G. G. Lindsay, M. D.
Security Benefit Association, Topeka, Kans.	F. R. Stearns, M. D.
Security Life and Accident Co., Denver, Colo.	D. S. Baughman, M. D. R. C. Scannell, M. D.
Security Life & Trust Co., Winston-Salem, N. C.	S. W. Hurdle, M. D.
Security Mutual Life Ins. Co., Binghamton, N. Y.	W. B. Aten, M. D. V. G. Hammond, M. D.
Shenandoah Life Insurance Co., Inc., Roanoke, Va.	D. S. Garner, M. D.
Southern Life Insurance Co. of Georgia, Atlanta, Ga.	D. Y. Sage, M. D.
Southland Life Insurance Co., Dallas, Texas	Hall, Shannon, M. D.
Southwestern Life Ins. Co., Dallas, Texas	C. F. Brown, M. D. H. E. Wiley, M. D.

Sovereign Life Assurance Co., Winnipeg, Canada	C. P. Neilson, M. D.
Standard Insurance Company, Portland, Oregon	E. L. Boylen, M. D.
Standard Life Association Lawrence, Kansas	G. D. Townshend, M. D.
Standard Life Assur. Co., Montreal, Canada	W. W. Eakin, M. D.
State Farm Life Insurance Co., Bloomington, Ill.	J. K. P. Hawks, M. D. E. M. Stevenson, M. D.
State Life Insurance Co., Indianapolis, Ind.	F. T. Hallam, M. D.
State Mutual Life Assur. Co., Worcester, Mass.	F. P. Bicknell, M. D. C. C. Beach, M. D. E. A. Reiman, M. D.
State Reserve Life Insurance Co., Fort Worth, Texas	Samuel Jagoda, M. D.
Sun Life Assurance Company of Canada, Montreal, Canada	C. C. Birchard, M. D. J. K. Gordon, M. D. A. W. Young, M. D.
Sun Life Insurance Co. of America, Baltimore, Md.	George McLean, M. D.
Sunset Life Insurance Co. of America, Olympia, Wash.	J. E. Toothaker, M. D.
T. Eaton Life Assurance Co., Toronto, Canada	C. V. Mulligan, M. D.
Texas Life Insurance Co., Waco, Texas	I. E. Colgin, M. D.
Texas Prudential Insurance Co., Galveston, Texas	E. R. Thompson, M. D.
Toronto Mutual Life Ins. Co., Toronto, Canada	J. A. A. Harcourt, M. D.

Travelers Insurance Company, Hartford, Conn.	J. T. Cabaniss, M. D. R. M. Filson, M. D. A. L. Larson, M. D. A. F. Seibert, M. D. Euen van Kleeck, M. D. V. H. Young, M. D.
Union Central Life Insurance Co., Cincinnati, Ohio	William Brueggemann, M. D. Edward Kuck, M. D. Charles Maertz, M. D.
Union Labor Life Insurance Co., New York City	W. L. O'Connell, M. D.
Union Life Insurance Co., Little Rock, Ark.	J. H. Hayes, M. D.
Union Mutual Life Insurance Co., Portland, Maine	H. E. Christensen, M. D.
United Benefit Life Insurance Co., Omaha, Neb.	N. L. Criss, M. D.
United Fidelity Life Insurance Co., Dallas, Texas	H. K. Crutcher, M. D.
United Life and Accident Ins. Co., Concord, N. H.	H. H. Amsden, M. D. P. M. L. Forsberg, M. D.
United States Life Ins. Co., New York City	J. A. Avrack, M. D.
Volunteer State Life Ins. Co., Chattanooga, Tenn.	J. B. Steele, M. D.
Washington National Insurance Company, Evanston, Ill.	I. E. Hoffman, M. D. P. C. Waldo, M. D.
West Coast Life Ins. Co., San Francisco, Calif.	I. C. Heron, M. D.
Western Life Assurance Company, Hamilton, Canada	G. E. Greenway, M. D.
Western Life Insurance Company, Helena, Mont.	T. L. Hawkins, M. D. E. H. Lindstrom, M. D.

Western Reserve Life Insurance Company, Austin, Texas	C. P. Hardwicke, M. D.
Western and Southern Life Ins. Co., Cincinnati, Ohio	C. M. Barrett, M. D. E. R. Bush, M. D.
Western States Life Insurance Company, Fargo, N. D.	T. H. Lewis, M. D.
Wisconsin Life Insurance Company, Madison, Wis.	G. G. Stebbins, M. D.
Wisconsin National Life Insurance Company, Oshkosh, Wis.	E. B. Williams, M. D.
Woodmen of the World Life Insurance Society, Omaha, Neb.	H. B. Kennedy, M. D.

AUTHOR INDEX

Vol. XXXIV — 1950

SUBJECT INDEX

Vol. XXXIV — 1950